THE ECHINODERM NEWSLETTER

Number 17. 1992

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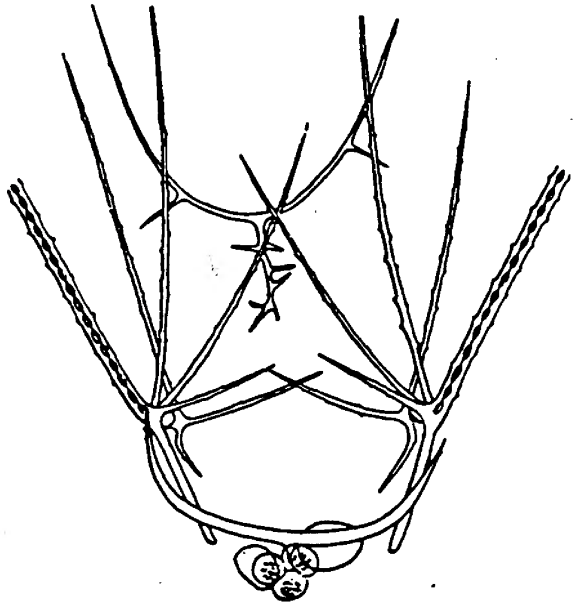
(David Pawson)

The newsletter contains information concerning meetings and conferences, publications of interest to echinoderm biologists, titles of theses on echinoderms, and research interests and addresses of echinoderm biologists. Individuals who desire to receive the newsletter should send their name, address, and research interests to the editor.

The newsletter is not intended to be a part of the scientific literature and should not be cited, abstracted, or reprinted as a published document.



Mortensen 1943

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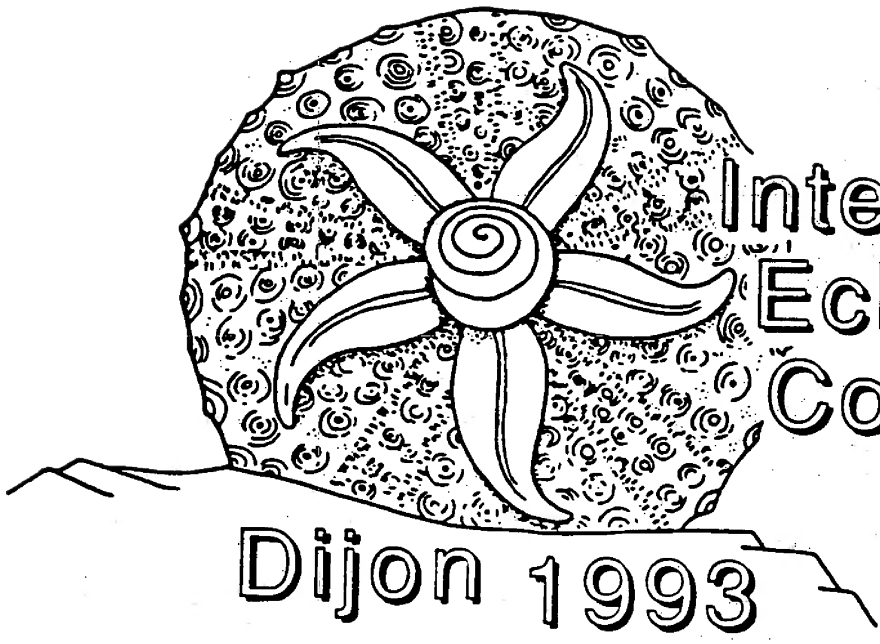
The series of International Echinoderm Conferences began in 1972 at the Smithsonian conference in Washington, D.C., organized by David Pawson and Maureen Downey. At that meeting, the participants decided that the conferences should be held every three years and that the site should be moved sequentially to different regions of the world to ensure that all echinoderm workers would have the opportunity to attend at some time. The general regions designated for the conferences were the Americas, Europe-Africa, and Asia-Antipodes.

Beginning with the Tampa Bay conference, the participants at the conference have selected the site of the next conference. The participants at the Atami conference addressed the possibility that a host selected for the next meeting might be unable to organize the conference as planned. They established a continuing committee consisting of the hosts of the previous meeting, the current meeting, and the subsequent meeting to have the responsibility of selecting a new site and host. The committee also has the responsibility of soliciting invitations for a site from the appropriate region for the next meeting if none is volunteered.

The current committee consists of Robert Burke (University of Victoria), Tomio Yanagisawa (Saitama Medical School), and Bruno David (University of Bourgogne).

International Echinoderm Conferences

1972 Washington, D.C., U.S.A.
1975 Roving, Yugoslavia
1978 Sydney, Australia
1981 Tampa Bay, U.S.A.
1984 Galway, Ireland
1987 Victoria, Canada
1990 Atami, Japan
1993 Dijon, France
1996



8th International Echinoderm Conference

Dijon 1993

The 8th I.E.C. will be held at the University of Burgundy, Dijon, on September 6 to 10, 1993.

Organizing committee

Chairmen: Bruno David (University of Burgundy)
&
Alain Guille (Laboratoire Arago, Banyuls)

Secretary: Annie Bussière (University of Burgundy)

Members: Jean-Pierre Féral (Laboratoire Arago, Banyuls)
Didier Néraudeau (University of Burgundy)
André Picard (Laboratoire Arago, Banyuls)
Michel Roux (University of Reims)
Andrew B. Smith (British Museum)

Dijon is a city of 200 000 inhabitants located on the North border of the Burgundy vineyard at about 300km from Paris, and 200km from Geneva. The first announcement will be mailed in April 1992. People who may be interested by complementary information are requested to contact Bruno DAVID before **September 30, 1992**:

8th I.E.C. - Bruno DAVID
Centre des Sciences de la Terre
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COTS COMMS

Issue Number 9 **May 1992**

7th International Coral Reef Symposium

The 7th International Coral Reef Symposium to be held in Guam in June is likely to be the last ICRS (for some time) to have a session devoted to *Acanthaster planci*. Dr Peter Moran of the Australian Institute of Marine Science is organising the session which will include the following presentations:

De'Ath, G. and P. Moran: A summary of ecological data on the crown-of-thorns starfish.

Yokochi, H., S. Ueno, M. Ogura, A. Nagai and T. Habe: Changes of diel feeding pattern with population density and food availability for *Acanthaster planci* (L.): an experimental view.

Stump, R.J.W.: Age and growth of *Acanthaster planci* (L.) from the Great Barrier Reef, Australia.

Fagerstrom, J.A.: Impact and recovery of reefs from an *Acanthaster planci* outbreak, Moorea, French Polynesia.

Mezaki, S.: Changing environments of coral reefs after infestations by *Acanthaster planci* in the Ryukyu Islands, Japan.

Keesing, J.K.: Role of *Acanthaster planci* in structuring reef communities in Okinawa, Japan.

Bradbury, R.H., R.M. Seymour and P.L. Antonelli: Is the Great Barrier Reef ecologically sustainable?

Fernandes, L., P.J. Moran and H. Marsh: A system for classifying outbreaks of crown-of-thorns starfish as a basis for management.

Lassig, B., W. Gladstone, P. Moran and U. Engelhardt: A crown-of-thorns starfish contingency plan.

ADDRESSES (Addendum and changes to list published in the 1991 newsletter)

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Balser, Elizabeth. Department of Biological Sciences, Clemson University, Clemson, South Carolina 29634-19031, U.S.A. (crinoids, axial organ)

Bazhin, Alexander. Kamchatka Department of Marine Biology and Biotechnology. PO Box 217, Petropavlosvsk-Kamchatsky 63000, Russia. (echinoid and asteroid taxonomy and ecology)

Belyaev, George M. P.P. Shirshov Institute of Oceanology. Krasikova St., 23, Moscow 117218, Russia. (Porcellanasteriid asteroids)

Birenheide, Rudiger. Biological Laboratory, Tokyo Institute of Technology, Ookayama, Meguro-ku, Tokyo 152, Japan. (ultrastructure of echinoid tissues)

Biryukova, Inga V. Pacific Research Institute of Fisheries and Oceanography, Laboratory of Physiology, 4, Shevchenko Alley, Vladivostok, 690600, Russia (olfactory systems of echinoids)

Borzone, Carlos A., Centro de Biologia Marinha, Universidade Federal do Parana, Av. Beira Mar s/no, 83235 Pontal do Sul, Paranagua, PR, Brazil (ecology of sand dollars)

Canicatti, Calogero. Department of Biology, University of Lecce, I-73100, Lecce, Italy. (echinoderm immune response, coelomocytes)

Dolmatov, Igor Yu. Laboratory of Comparative Cytology, Institute of Marine Biology, Vladivostok 690032, Russia. (moorphology, regeneration, development of holothuroids)

Drozdov, Anatolly L. Laboratory of Cytoembryology, Institute of Marine Biology, Vladivostok, 690032, Russia. (Gametes, Fertilization, Phylogeny of echinoderms)

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Gebruk, Andrew V. P.P. Shishov Institute of Oceanology, 23 Krasikova St., 117218 Moscow, Russia. (deep-sea holothuroids)

Hartsock, Franklin B. National Marine Fisheries Service, P.O. Box 1638, Kodiak, Alaska 99615, U.S.A. (regeneration of asteroids)

Hodgson, Alan N., Department of Zoology and Entomology, Rhodes University, PO Box 94, Grahamstown 6140, South Africa). (reproductive biology)

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Kasyanov, Vladimir. Institute of Marine Biology, 690032 Vladivostok, Russia. (reproduction of echinoiderms)

Kushlina, Vernonika B. Paleontological Institute, Profsojuznaja ul., 123, 1171868 GSP-7 V-321 Moscow, Russia. (evolution, systematics, morphology and ecology of Cretaceous hemiasterids and micraterids, Ordovician Bolboporites)

Leibson, Nina L. Institute of Marine Biology, Vladivostok 690032, Russia. (Regeneration in holothuroids)

Levin, Valery S. Kamchatka Department of Marine Biology and Biotechnology, PO Box 197, Petropavlosvsk-Kamchatsky 863000, Russia (Ecology, Biochemistry and Fisheries of holothuroids and echinoids

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Maharavo, Jean. Station Marine. B.P. 141, 106 Tulear, Madagascar. (biology of Tripneustes)

Manchenko, Genady. Institute of Marine Biology, 690032 Vladivostock, Russia. (Population genetics of echinoderms)

Markov, Alexander V. Paleontological Institute, Profsojuznaja ul., 123, 117868 Moscow, Russia. (Evolution and systematics of echinoids, morphogenesis)

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Marshall, Charles. Department of Earth and Planetary Sciences, Univ. of California, Los Angeles, CA 90024-1567. (Evolution and systematics of echinoids)

Mironov, Alexander, P.P. Shirshov Institute of Oceanology, Krasikova St., 23, 117218 Moscow, Russia. (Taxonomy, ecology, zoogeography of echinoids and asteroids)

Mocretsova, Nina D. Pacific Research Institute of Fisheries and Oceanography, 4, Shevchenko Alley, 690600 Vladivostok, Russia. (Reproduction, nutrition, and development of holothuroids).

Naidenko, Tamara Kh. Institute of Marine Biology, 690032 Vladivostok, Russia. (Development and culture of echinoids)

Norris, Daniel R. Marine Laboratory, Univ. of Guam, UOG Station, Mangilao, Guam 96923. (ecology of spatangoids)

Okamoto, Kyoko. Geological Institute, Univ. of Tokyo, Hongo, Tokyo 113, Japan. (paleontology, ecology, systematics, evolution, biogeography of echinoids)

Payot, Florence. Institute of Biology, Odense University, Campusvej 55, DK 5230 Odense. (heavy metals)

Propp, Michael. Institute of Marine Biology, 690032 Vladivostok, Russia. (Physiology of echinoids)

Rominas-Castro, Lily. National Institute of Fisheries, P.O. Box 1306, Ensanada, Baja California, Mexico. (fisheries of sea urchins and sea cucumbers)

Rozhnov, Sergey V. Paleontological Institute, Profsoyuznaja ul., 123, Moscow Russia, 117868. (Origin, systematics, morphogenesis of Lower Paleozoic, Cambrian, and Ordovician echinoderms)

Ryabushko, Vitali I. Department of Animal Physiology, Institute of Biology of the South Seas, Nakhimov Ave., 2. Sevastopol 335000, Ukraine. (echinoderm physiology, energetics)

Scally, Kevin Bernard. Dental Department, Christchurch Hospital, Private Bag, Christchurch, New Zealand. (paleontology, behavior, anatomy, functional morphology, evolution of echinoids)

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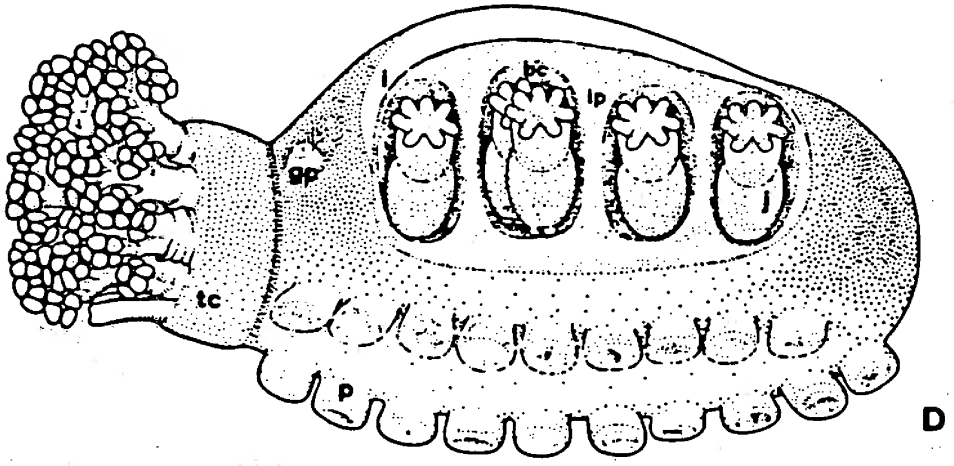

Fig. 1. *Neocnus incubans*. A. Dorsal view of an adult individual. B. Dissected individual showing the left brooding chamber. C. Detail of the brooding chamber with juvenile individuals *in situ*. D. Schematic drawing of a dissected *N. incubans* showing a brooding chamber with four compartments holding juveniles. bc, brooding compartments; gp, genital papilla; i, integument; ip, integumentary partition; j, juveniles; ms, marsupial slit; p, podia; tc, tentacular crown.

Alva & Jangoux. A92. in Echinoderm Research. 1991.

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BOOKS IN PRINT

Windsor, M.P. 1991. Reading the shape of nature: comparative zoology at the Agassiz Museum. The University of Chicago Press, Chicago.

Echinoderm workers are fortunate that Windsor's interests in the history and philosophy of science involve the phylum. Her first book (Starfish, jellyfish, and the order of life. 1976. Yale University Press, New Haven. out-of-print) examined the problem of diversity in the 19th century with the Radiata as the focus. This present book continues her analysis of evolutionary thought, but it is more. It is also more than just a history of that institution. Windsor provides a fascinating account of the personalities of the Agassiz's and those students and scientists with whom they interacted, and the way personalities affected the course of the development of the MCZ as well as of science. In this regard, the book is an important contribution to understanding the history of the development of the study of biology, but also of the development of graduate instruction in the United States and the roles of universities and research institutes.

In final analysis, however, the book is indeed a history of the MCZ, but the implications of the study reach beyond that institution, as the author makes clear in her final chapter. Here is a very succinct, pertinent account of the nature of museums in general: their origin, their changes, their roles. This is particularly pertinent now as the functioning of the great museums of the world is once again called into question. Her conclusion that museums are tools, equivalent to scientific tools, is an important one .

McKinney, M.L., K.J. McNamara. 1991. Heterochrony: The evolution of ontogeny. Plenum Press, N.Y.

Heterochrony has become an important aspect of the study of development and evolution. The book contains a history of the ideas of heterochrony, means of classifying and anlayzing heterochrony, the cellular causation of heterochrony, action on the variation produced by heterochrony, evolutionary patterns produced by heterochrony, targets of selection of heterochrony. The last chapter considers the role of ontogeny in evolution. Heterochrony has been applied to echinoderms by investigators reaching back to the 19th century. Both authors of this book have studied echinoids, which serve as examples in the discussion. This should be a very useful book.

"Now there are found in Silurian and Devonian rocks a considerable number of fossils exactly intermediate between Asteroidea and Ophiuroidea. We have every reason to believe that in these fossils we possess the actual record of the evolution of the Ophiuroidea, and we are therefore in a position to test how far the history of the individual, as disclosed by embryology, agrees with the history of the race. Now these fossils show an open ambulacral groove, and ambulacral ossicles not yet central to form vertebrae, but in the larvae the open ambulacral groove becomes closed long before there is any trace of vertebrate, and while the adult arms are still mere stumps. Hence we conclude that in the larval history there has been a <u>dislocation of the sequence of events</u>, and the formation of the epineural folds has been hurried on long before its time--in a word, that these flaps have been <u>precociously maintained</u>....

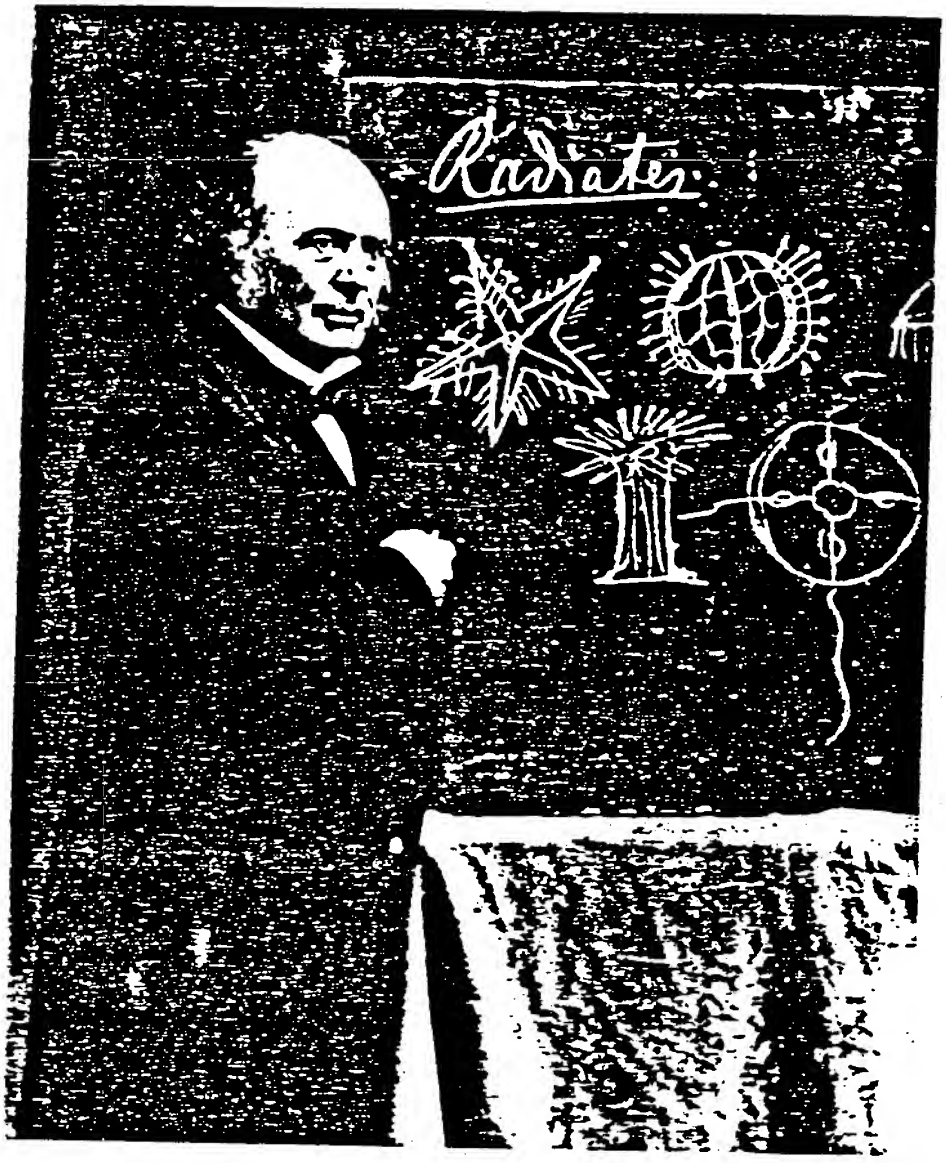
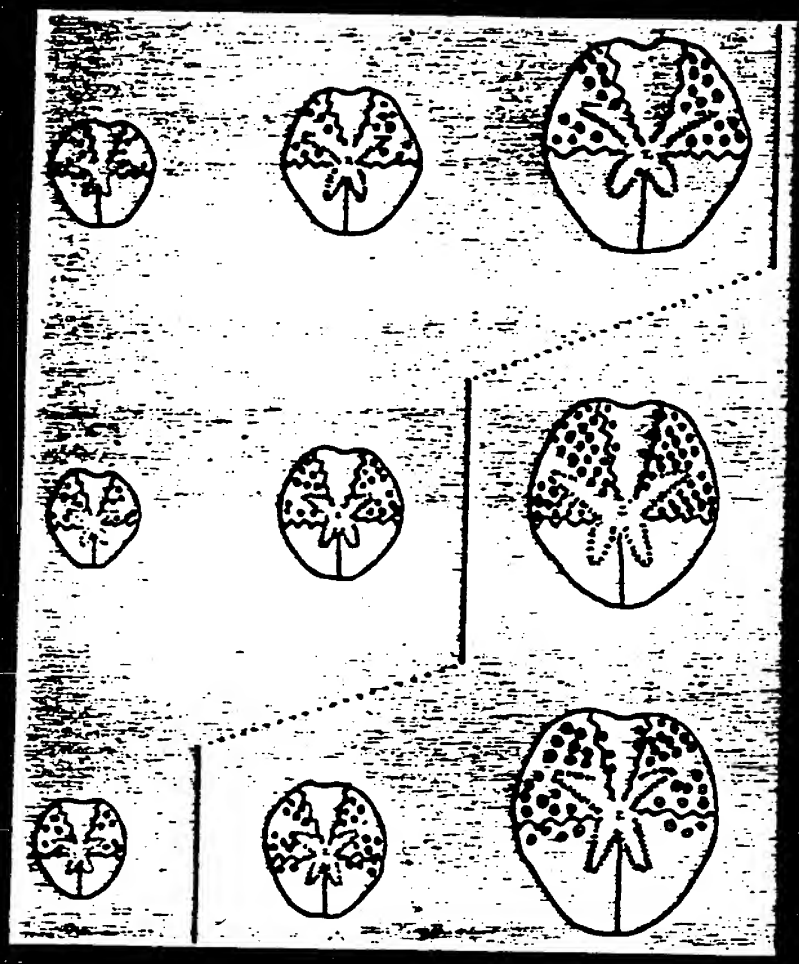


Figure 3. Louis Agassiz lecturing on one of his favorite subjects, the homology of the "Radiates": starfish, sea urchins, sea anemones, and jellyfish. By permission of the Museum of Comparative Zoology Archives, Harvard University)

from Windsor.
Reading the Shape of Nature

Heterochrony

The Evolution of Ontogeny



Michael L. McKinney
and
Kenneth J. McNamara

The (echinoid) imago thus launched on its career is very different from the fully grown adult. In fact, if the long primary tube feet were supported by outgrowths of the body we should have a young Asteroid before us. There is little doubt that this post-larval stage represents a former Asteroid ancestor....
The adult anatomy of a Holothuroid suggests the view that the group may have been derived from early Echinoidea in which the test consisted of plates movable on one another. This view is strengthened by the complete armour of plates in which the young *Cucumaria* is enveloped, and which gradually become separated from one another as the animal grows older...But if the Echinoidea and Holothuroidea have diverged from a common stock, then the Echinoid lara has been much modified since that time in its external appearance; whilst in the Holothuroid larva the internal asymmetry in the development of the coelom has been pushed back to a very early periodof development."
MacBride. 1914. Textbook of Embryology. Vol. 1. Invertebrates.

Gage, J.D., P.A. Tyler. 1991. Deep-sea biology: A natural history of organisms at the deep-sea floor. Cambridge University Press, Cambridge.

Gage and Tyler are well known for their extensive deep-sea studies primarily of the Rockall Trough. These studies have frequently involved echinoderms. The book provides a broad coverage of the characteristics of the deep sea, the taxa found there and their natural history. It also describes the biological processes of the organisms found there, including feeding, respiration, reproduction, growth, and dispersal. The latter is particularly important as it provides the basis for interpreting the ways deep-sea organisms function in one of the great biomes on earth. Specifically for echinoderm workers, the authors give a general overview of of the phylum, pointing out that the ophiuroids, asteroids, echinoids and holothuroids are the most important of the errant megafauna, with the crinoids being conspicuous sessile megafauna. Marvellously little is known of the feeding processes in deep-sea echinoderms; respiration has been measured for several ophiuroids; most information on reproduction and recruitment is for echinoderms (primarily from the authors' laboratories). The book is well written.

"Species nearly allied to those found in shallow water of many familiar genera were taken in the deepest hauls, so that it would seem that the enormous pressure, the utter darkness, and the differences in the chemical and physical conditions of the water, and in the proportions of its contained gases,do not influence animal life to any great extent." Wyville Thomson. 1887. Challenger. Atlantic.

Imaoka, T., S. Seiichi, T. Okutani, C. Oguro, T. Oji, K. Kanazawa. 1991. Echinoderms from continental shelf and slope around Japan. Vol. II. Japan Fiush. Res. Conserv. Ass., Tokyo Suisan Bldg., 6th Floor, Toyomi 4-18, Chuou-ku, Tokyo 104, Japan.

Volume I of this two-part series appeared in 1990. It contains descriptions of 84 species of echinoderms, ioncluding four new species. The second volume contains descriptions of an addtional 79 species, including three new

species. Each description has marvellous photographs of most species in color. Additional photographs in black and white provide details. The text provides a description of the species and distribution range. The book meets its goal of providing taxonomic data useful for marine biology and fisheries.

Giese, A.C., J.S. Pearse, V.B. Pearse. 1991. Reproduction of marine invertebrates. Vol. VI. Echinoderms and lophophorates. The Boxwood Press, Pacific Grove.

The long-awaited volume on echinoderms in this well-known treatise on invertebrate reproduction will be extremely useful to researchers in the field. For each of the major groups, sections on asexual reproduction, sexual reproduction, and development are presented. They include thorough descriptions of structure and function, and mechanisms of action. The volume will serve as the authoritative reference for the state of the field.

Holland, N.D. Echinodermata: Crinoidea
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Rowe, F.W.E., D.T. Anderson, J.M. Healy. Echinodermata: Concentricycloidea

Shokita, S., K. Kakazu, A. Tomori, T. Toma (eds.). Aquaculture in tropical areas. Midori Shobo Co., Ltd, Ikebukuro Nishiguchi Sky Building, 2-14-4 Ikeburo, Toshima-ku, Tokyo, Japan. (English edition prepared by M. Yamaguchi).

This volume contains a chapter on sea cucumbers (by Masashi Uehara) that has brief statements about nine species with a brief description of procedures for obtaining eggs and culture of larvae, and a chapter on *Tripneustes gratilla* (by Shinko Shimabukuro) that discusses its ecology and life history.

Stachowitsch, M. 1992. The invertebrates: an illustrated glossary. Wiley-Liss. This book defines the basic terminology of the anatomy of invertebrates (systematic section) and variations of structures specific for a group (adjective section). A page illustrates the basic anatomical features of each group. Entries are in English and German.

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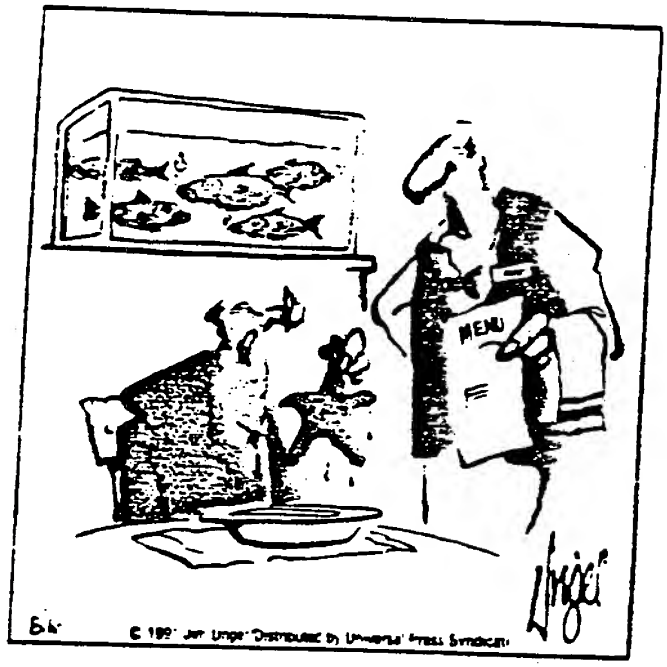
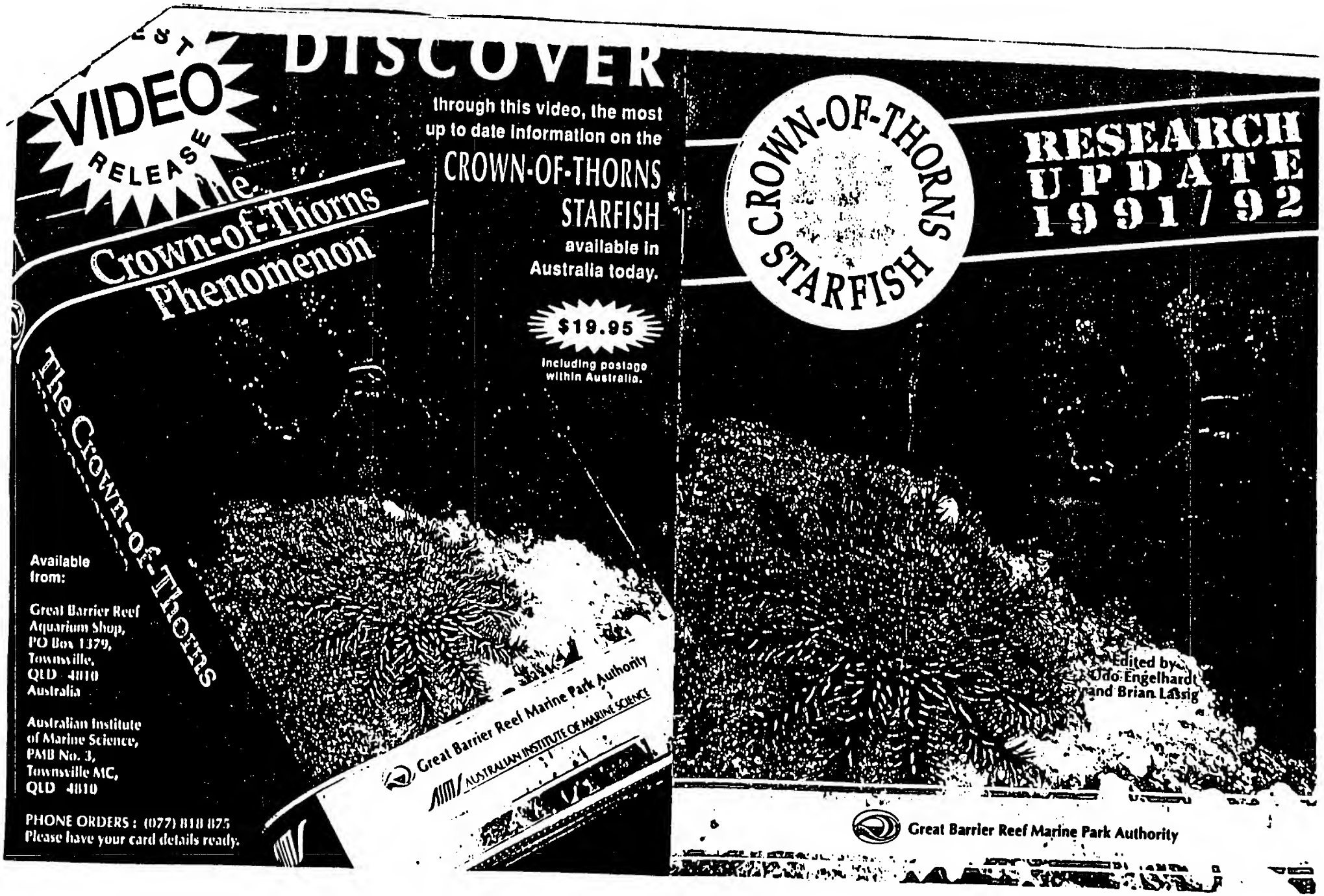


HERMAN
By Jim Unger

"That's what you pointed at in the tank!"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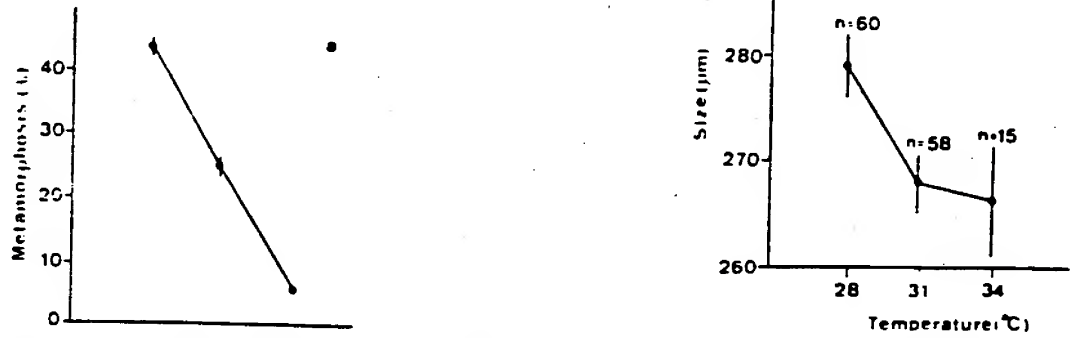

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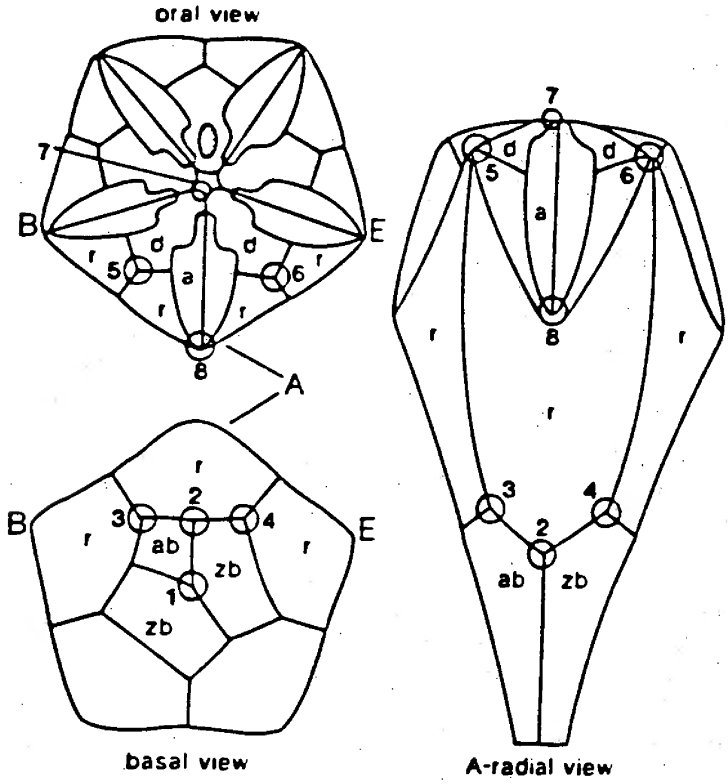

FIG. 1— Generalized blastoid theca showing morphological landmarks. 1, conjunction of three basal plates; 2, conjunction of A-radial, E-zygous basal, and azygous basal; 3, conjunction of A-radial, B-radial, and azygous basal; 4, conjunction of E-radial, A-radial, and E-zygous basal; 5, conjunction of A-radial, B-radial, and AB deltoid; 6, conjunction of E-radial, A-radial, and EA deltoid; 7, most adoral point on AB deltoid; 8, most aboral point on A-ambulacrum. Abbreviations: a, ambulacrum; ab, azygous basal; d, deltoid; r, radial; z, zygous basal; A, B, and E refer to rays.

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NORTH ATLANTIC THYONIDIINAE AND SEMPERIELLINAE

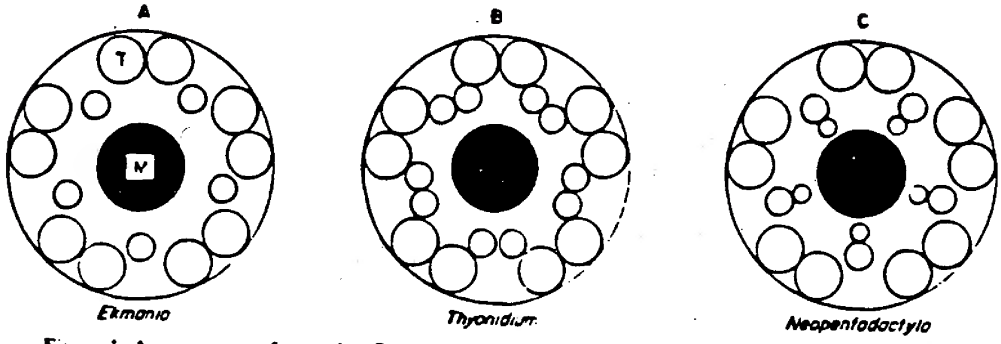

Figure 1. Arrangement of tentacles. Open circles (T) indicate individual tentacles. The diameter of the circles indicates the comparative size of each tentacle. The closed circle (M) represents the centrally placed mouth.

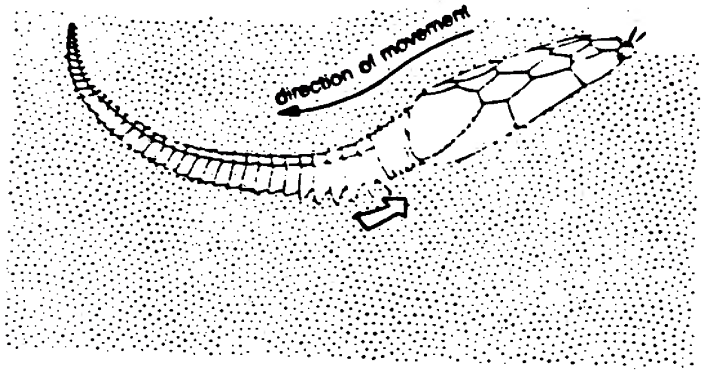

FIGURE 5—Inferred life mode of the mitrate carpoids based on reconstruction of *Ateleocystites guttenbergensis*. Contraction of the inferior side of the proximal part of the aulacophore caused the spine bearing ossicles to push forward against the sediment (open arrow) pulling the animal down into the substrate aulacophore-first.

Keiata et al. 1991

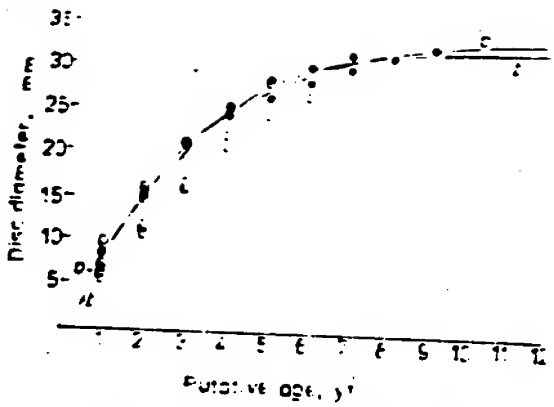

Fig 10. *Ophiomusium lymani*. Measurements (●) standardised to inferred disc diameter of growth stages of growth bands measured from ridges visible on SEM photograph of lower "fossa" shown in Fig 8B and from opaque bands visible in "cleared" ossicle shown in Fig 9C; growth-ring measurements from remaining specimens examined. Growth curves (a) Von Bertalanffy, b. Gompertz) are fitted to first six of data (●) only. Fitted parameters – a $DD_\infty = 33.2$, $A = 0.3$, $t_i = 0.25$; b $DD_\infty = 31.13$, $A = 0.5$, $t_i = 1.5$). Further details as in legend to Fig 4

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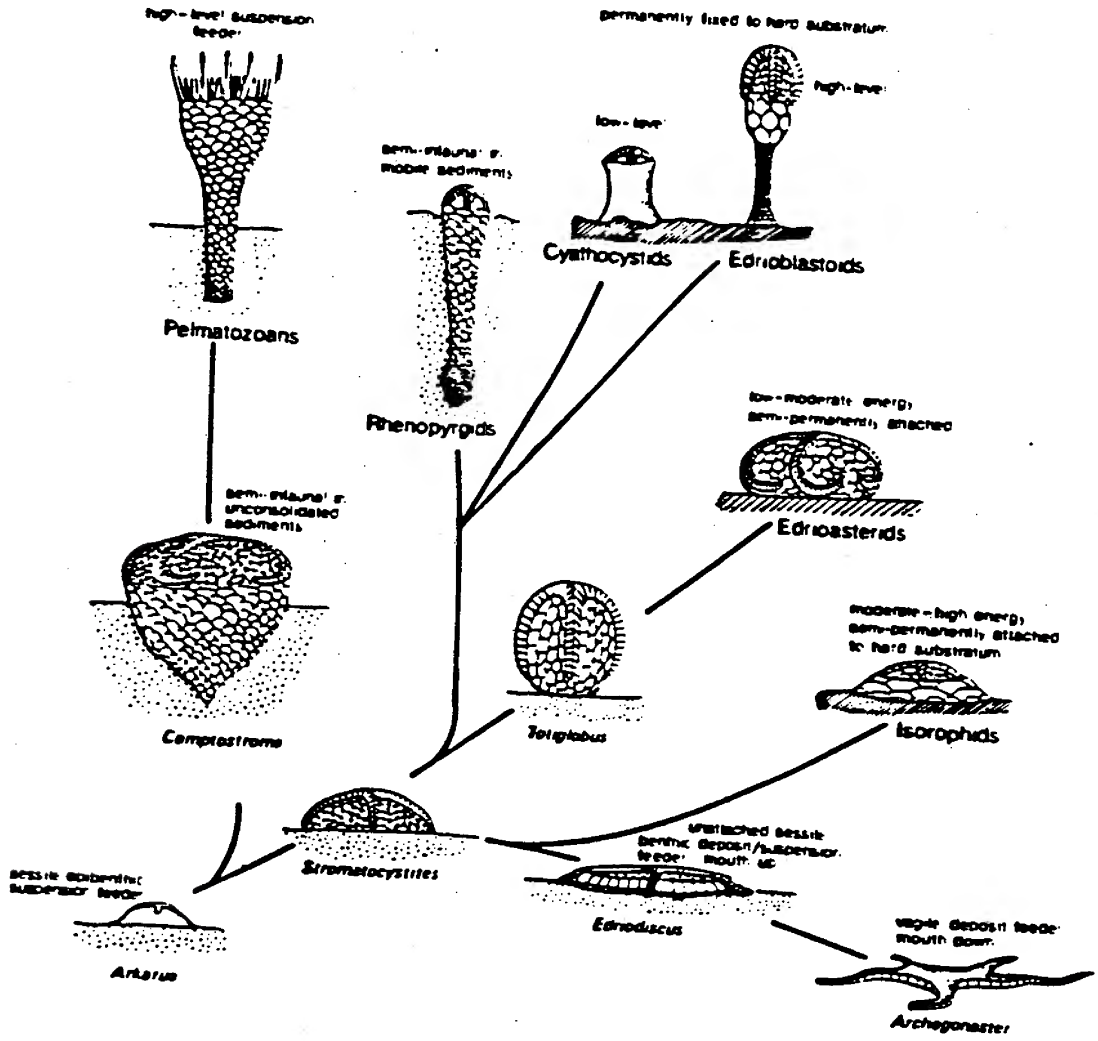

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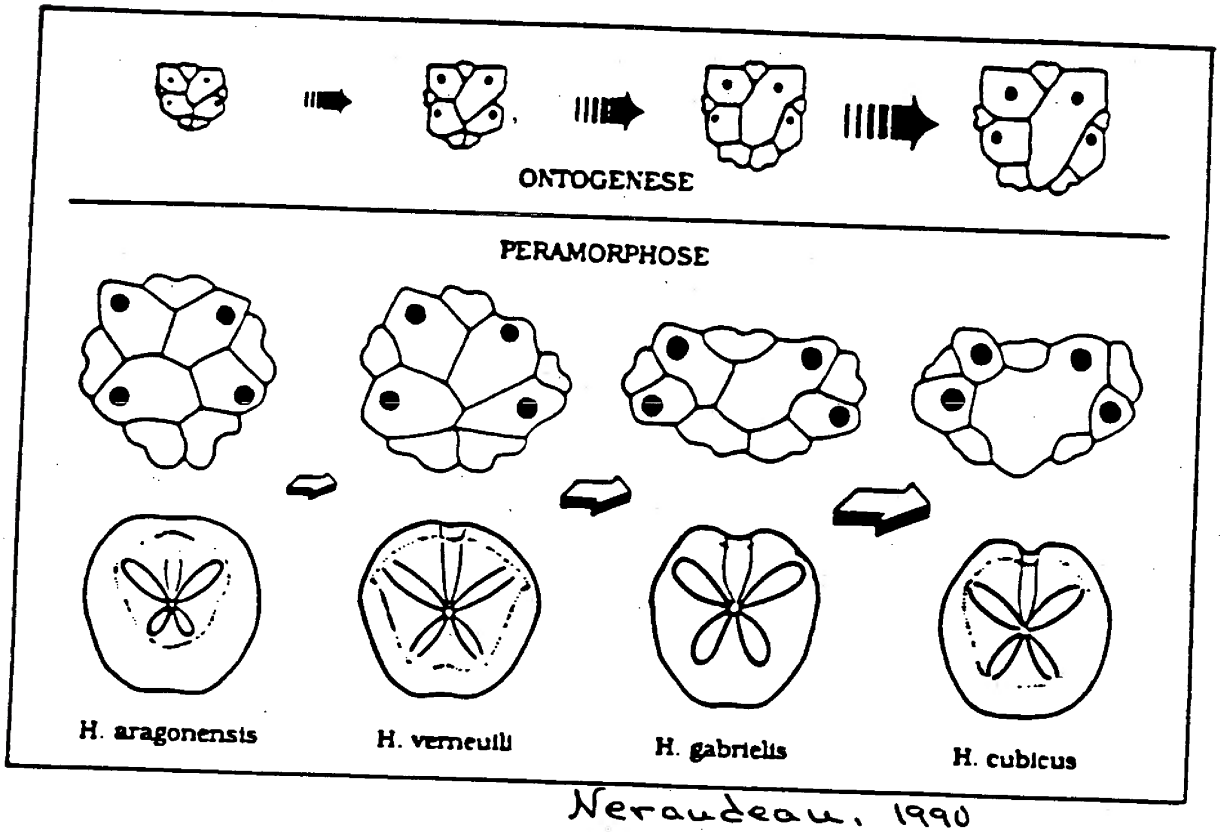

Neraudeau, 1990

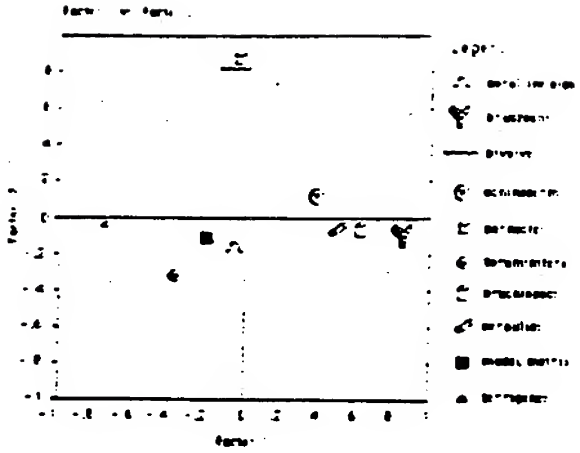

Fig. 5. Factor loading following varimax rotation of factor (highly positive loading of bryozoans brachiopods serpulids and echinoderms and highly negative loading of terrigenes) plotted against factor 2 (highly positive loading of barnacles and bivalves)

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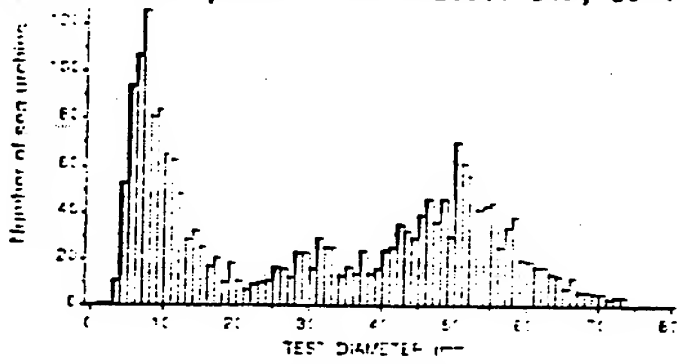

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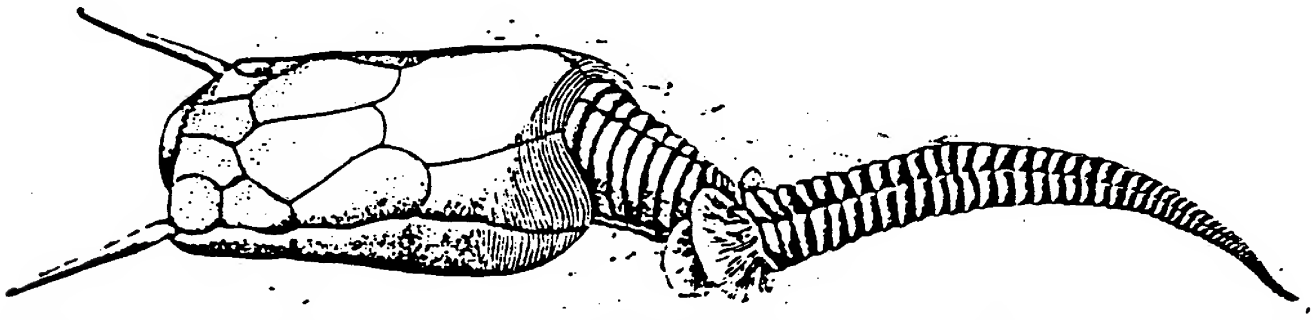

Text-figure 2.—Reconstruction of *Enoploura popei* in its normal feeding orientation. This figure is based on UCM 25993 (Pl. 6, figs. 1–3). While the styloid and proximalmost distal aulacophore segments bite into the sediment for stability, with additional buttressing from the distal spines, the distal aulacophore curves convexly over the substrate to feed. The openings thus formed between the fused cover plates are chevron-shaped to narrowly hemi-elliptical, but are large enough to admit food particles to the food groove. Current direction is from right to left. Parsley. Bulls. Am. Paleontol. 100 (336). 1991.

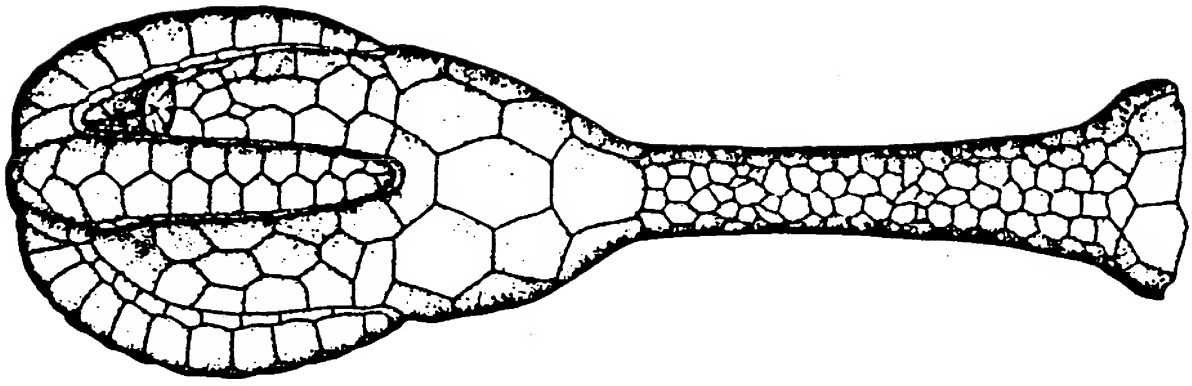

FIG. 33. *Cambroblastus enubilatus* sp. nov. reconstruction. Smith, Sadler 1991

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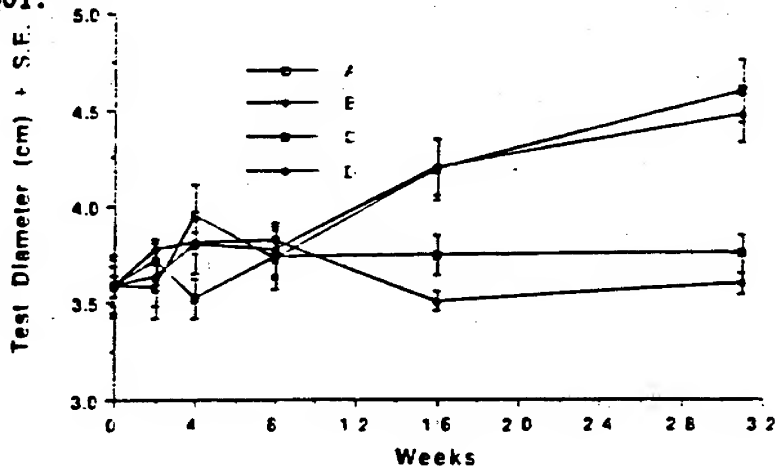

Fig 1. Change in mean test diameter ± SE for each treatment. The mean of the group dissected immediately after collection at False Point serves as the 0-wk mean for each treatment. Treatment A, control. Treatment B, fed and spines clipped. Treatment C, starved. Treatment D, starved and clipped.

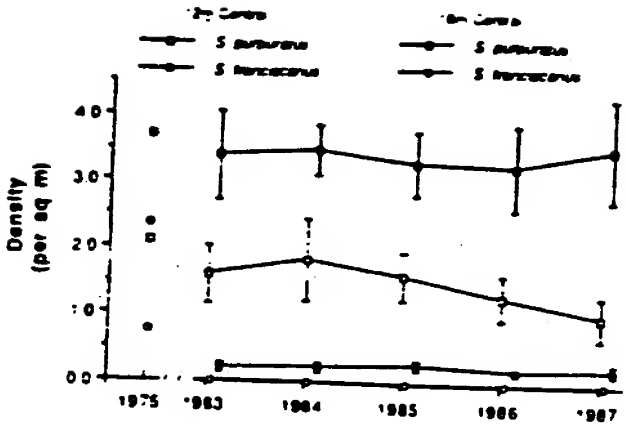

Fig 10 *Strongylocentrotus purpuratus* and *S. franciscanus*. Comparison of purple and red urchin densities in 1975 and 1983–87 at 12 and 18 m C sites determined from the transect lines. Error bars represent 95 % confidence limits

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J.B. McCLINTOCK AND S.A. WATTS

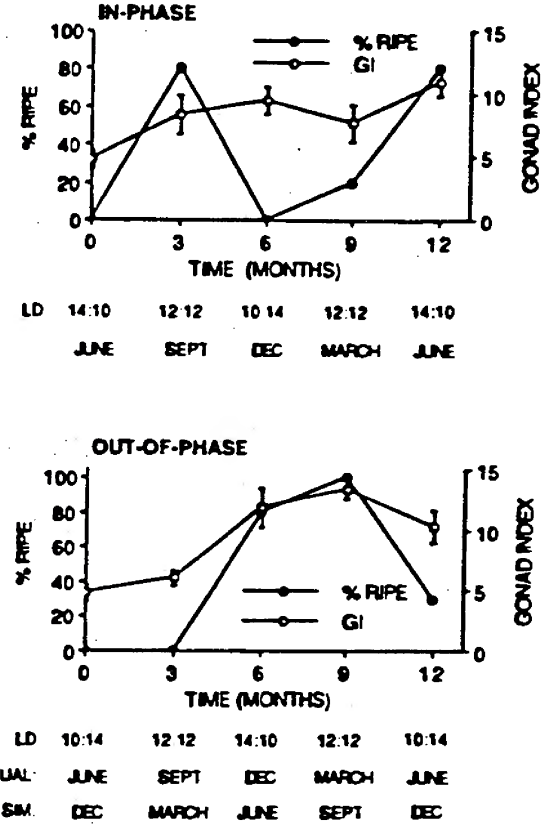

Fig 1. Mean ± 1 SD (n = 10) gonadal indexes (open circles) and percentages of ripe individuals (closed circles) for the tropical sea urchin *E. tribuloides* held under variable in-phase and out-of-phase photoperiods for 1 yr. Ripe individuals were considered those with oozing gonads and active spermatozoa or large, uniformly sized, ova. Experiments were conducted from June 1988 to June 1989. Both actual and simulated (SIM) photoperiod regimes are shown.

PAPERS PRESENTED AT SCIENTIFIC MEETINGS

53o Congressso dell'Unione Zoologica Italiana (October 1990, Palermo)

Francesco, A., I.C. Wilkie, M.D. Candia Carnevali, F. Bonasoro. Aspetti fisiologici della membrana peristomiale di Paracentrotus lividus: un esempio della presenza di tessuto connettivo a tensilita' variabile (MCT).

Candia Carnevali, M.D., F. Bonasoro, I.E. Wilkie. Morfologia funzionale della membrana peristomial de Paracentrotus lividus.

Eleventh Annual Gulf of Mexico Information Transfer Meeting (November 1990, New Orleans) (communicated by T. Hopkins)

Hopkins, T.S., J.F. Valentine, J.B. McClintock, K.R. Marion, S.A. Watts. Echinoderms associated with a rhodolith community on the Alabama outer continental shelf: management considerations for a unique environmental setting.

McClintock, J.B., S.A. Watts, K.R. Marion, G. Shinner, T.S. Hopkins. Variation in reproductive patternsin echinoderms from the northern Gulf of Mexico.

Hopkins, T.S., M.W. Cornett, J.B. McClintock, K.R. Marion, S.A. Watts. Secondary production: differtential arm loss in two sympatric species of sand stars.

Sixteenth Annual Albert L. Tester Memorial Symposium (1991, Honolulu) (abstract published in Pacific Science, 46, 1992)

Metz, E.C. Role of sperm surface protein bindin in maintenance of reproductive isolation between Hawaiian sea urchins. (p. 99).

THE COST 647 PROJECT ON COASTAL BENTHIC ECOLOGY

Communicated by Brendan Keegan

COST (Cooperation europeenne dans la domaine de la Recherche Scientifique et Technique) is a framework and forum for the study of benthic ecology in European waters that existed from 1979 to 1990. Studies on echinoderms that have come from the project include:

Echinocardium cordatum

Beukema, J.J. 1985. Growth and dynamics in populations of Echinocardium cordatum living in the North Sea off the Dutch north coast. Neth. J. Sea. Res. 19, 129-134.

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Acrocnida brachiata

Bourgoin, A. 1985. Acrocnida brachiata (Echinodermata: Ophiuroidea): intertidal, subtidal populations in Brittany. In: B.F. Keegan & B.D.S. O'Connor (eds.). Echinodermata. Balkema, Rotterdam. p. 653.

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Georges Ubaghs PARI

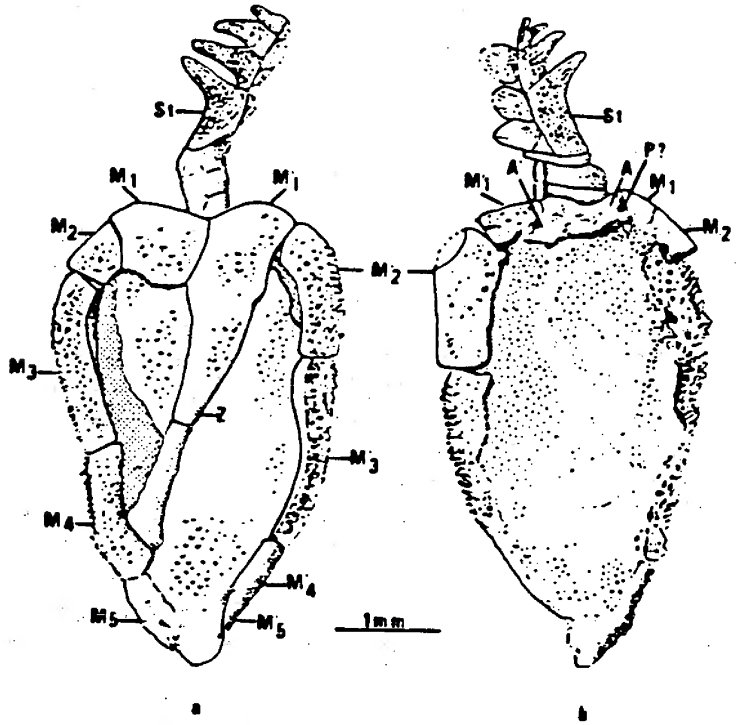

Fig. 2. *Nanocarpus dolambii* n. g., n. sp. Holotype (VOMN 142) a: face inférieure, b: face supérieure. - Explication des lettres: A et A' = adaulacophorales droite et gauche; M - M. = marginales droites; M'1 - M'. = marginales gauches; P ? = hydropore?; St = stylocone; Z = zygale.

Abb. 2. *Nanocarpus dolambii* n. g. n. sp. Holotyp (VOMN 142). a: Unterseite, b: Oberseite. - Abkürzungen: A und A' = rechte und linke Adaulacophoralplatten; M - M. = rechte Marginalplatten; M'1 - M = linke Marginalplatten.

PROCEEDINGS OF THE THIRD EUROPEAN CONFERENCE ON ECHINODERMS
LECCE / ITALY / 9-12 SEPTEMBER 1991

Echinoderm Research 1991

Edited by
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University of Lecce

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Developmental biology

PAPERS PRESENTED AT THE ANNUAL MEETING OF THE AMERICAN SOCIETY OF ZOOLOGISTS
DECEMBER 1991. ATLANTA, GEORGIA.

Welborn, J.W., D.T. Manahan. Biochemical responses of Antarctic asteroid larvae to dissolved organic matter.
Shilling, F.M., D.T. Manahan. Using dissolved organic matter to meet the metabolic needs of development in an extreme environment (Antarctica).
Hoegh-Guldberg, O., D.T. Manahan. Metabolic requirements during growth and development of echinoderm larvae.
Levitan, D.R. Fertilization success and the evolution of egg size in echinoderms.
Pearse, J.S., I. Bosch, V.B. Pearse, L.V. Basch. Bacterivory by bipinnarias: in the Antarctic but not in California.
Bishop, C.D., S.A. Watts. The physiology of growth in the stomach and large intestine of the sea urchin Lytechinus variegatus.
Beddingfield, S.D., J.B. McClintock, K. Marion, T.S. Hopkins. Feeding biology of Astropecten articulatus.
Lawrence, J.M., M. Byrne, M.F. Barker. Body size, arm number, and gonad and pyloric caeca production in antipodian Patiriella.
Lawrence, J.M., S. Bell, B. Robbins. Scaling and interspecific variation in sizes of the pieces of the Aristotle's lantern of strongylocentrotid echinoids.
Stickle, W.B., D.W. Foltz, M. Katoh, H.L. Nguyen. Genetic structure in five species of seastars (Echinodermata: Asteroidea) from Alaska.
Walker, C.W., J.G.D. Boom, A.G. Marsh. c-Myc is not exclusively a vertebrate gene. (asteroid)
Deaton, L.E. Preliminary characterization of holothuroid evisceration factor.
Bigger, C.H. Characteristics and distribution of the leukocytes of the sea star Dermasterias imbricata.
Janies, D.A., L.R. McEdward. Evolutionary significance of a derived mode of coelom formation in the larva of the starfish, Pteraster tesselatus.
McEdward, L.R. Interspecific relationships between egg size and the level of parental investment per offspring in echinoderms.
Sewell, M.A. Protandy in the sea cucumber Leptosynapta sp.
Emlet, R.B. Global and historic patterns of nonfeeding larval development in sea urchins.
Gilmour, T.H.J., Induction of metamorphosis of echinoid larvae.
Hopkins, T.S. The distribution of the echinoid genus Clypeaster in the Caribbean seas: a case for "relictual centers of survorship."
Young, C.M. Reproductive studies in the deep sea: historical perspectives.
Gage, J. Recruitment ecology and age structure of deep-sea populations.
Lares, M.T., J.M. Lawrence. Allocation of nutrients and energy during arm regeneration in Echinaster sp. (Echinodermata: Asteroidea).
Clements, L.A.J., S.S. Bell, J.P. Kurdziel. Secondary production from arm regeneration in natural and replanted seagrass beds.
Young, C.M. Fertilization ecology of deep-sea echinoderms.
Eckelbarger, K.J. Ultrastructural modifications of gonads and gametes in bathyal and abyssal invertebrates.
Pearse, J.S. Do deep-sea echinoderms reproduce like those in shallow antarctic seas?
Tyler, P.A. Seasonality and continuity in reproductive processes in deep sea invertebrates. (asteroids, echinoids)

Papers presented at the Sixty-second Annual Meeting of the Zoological Society of Japan (Okayama, 1991)
(abstracts published in Zoological Science, vol. 8, 1991)

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Matsuoka, N. Phylogenetic relationships of echinoderms deduced from kinetic similarity of glucose-6-phosphate dehydrogenase. p. 1196.

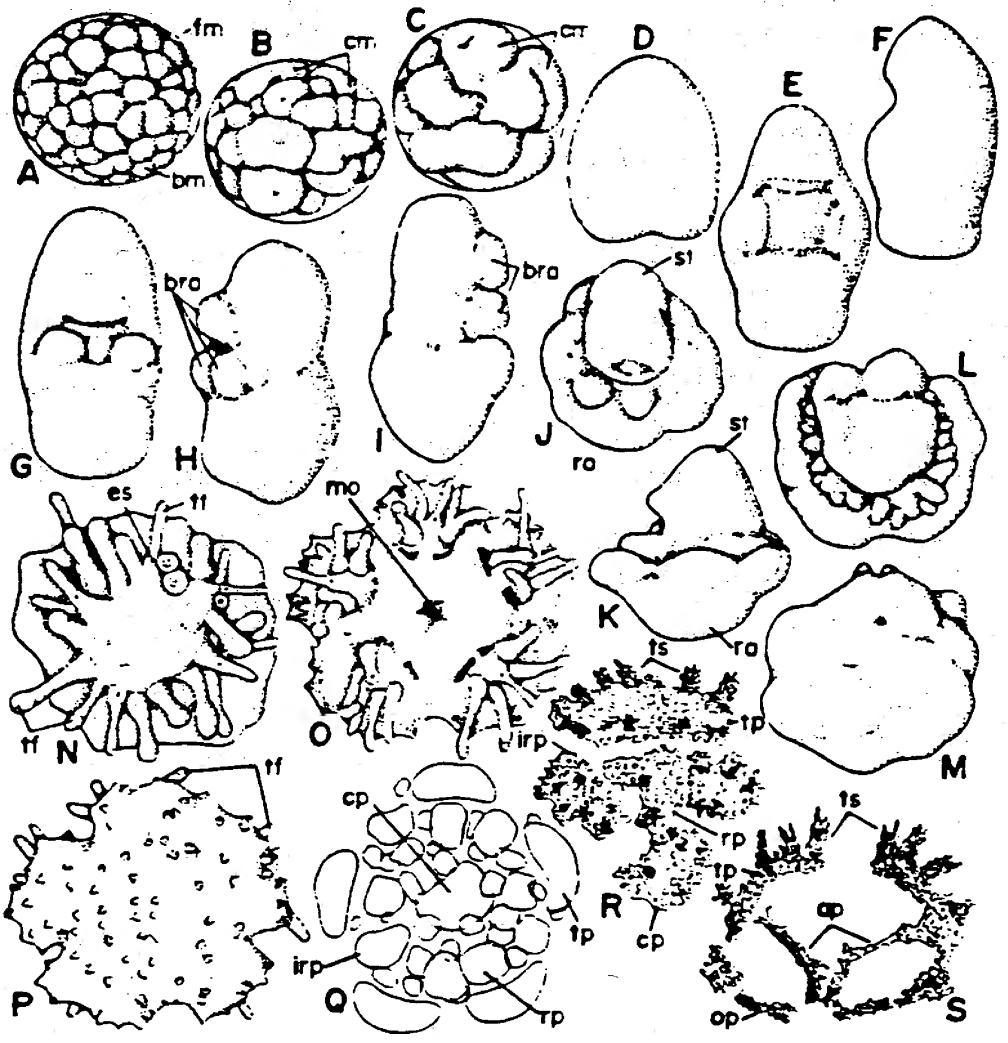

Figure 4. Development of *Asterina pseudoexigua pallida*

Komatsu et al. 1990

Papers presented at the 19th Annual Marine Benthic Ecology Meeting, Williamsburg, Virginia, USA (1991)
(communicated by James B. McClintock)

Aitken, A.E. Baffin Island fiord and continental shelf macrobenthos (ophiuroids are a dominant)

Aronson, R.B. Fishing pressure and the evolution of benthic communities. (echinoids)

Bock, M.J., D.C. Miller. Movement of shelf echinoderms in oscillatory flows. *(Echinarachnius, Amphiura, Astropecten)*

Clements, L.A., J.P. Kurdziel, S.S. Bell. Secondary production in seagrass beds estimated through arm regeneration by an infaunal brittlestar.

Cronin, G., M.E. Hay. Can an alga tell the difference between amphipod and urchin grazing?

Forbes, T.L., V.E. Forbes. The functional allometry of deposit feeding in the southeast Asian holothurian, *Holothuria atra.*

Golde, H.M., S.E. Stancyk, M.P. Crosby. Respiration rates of regenerating brittlestars.

Kvitek, R.G., J.S. Oliver. Sea otters as predators and disturbers in Alaskan soft-bottom communities.

McClintock, J., M. Slattery, J. Heine, J. Weston. The chemical ecology of Antarctic marine invertebrates. (echinoderms)

Pape-Lindstrom, P.A., R.J. Feller, H.M. Golde, S.E. Stancyk. Sublethal predation: invisible energy flow? (ophiuroids)

Schinner, G.O. Burrowing behavior, substratum preference, and distribution of *Schizaster canliferus* (Echinoidea: Spatangoida) in the northern Adriatic Sea.

Stancyk, S.E., W.E. Dobson. Use of skeletal growth bands in ophiuroid arm ossicles to quantify frequency of sublethal predation.

Valentine, J.F., K.L. Heck. The role of dense mussel assemblages in controlling macrofaunal assemblages and seagrass biomass in the northern Gulf of Mexico. (echinoids)

Vernon, J.D., J.B. McClintock, T.S. Hopkins. Size frequency and sediment selectivity of the irregular echinoid *Clypeaster ravenelii.*

Wulff, J. Sponge-feeding by the Caribbean starfish *Oreaster reticulatus.*

1990 ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA -- DALLAS, TEXAS, October 29 to November 1, 1990. Geological Society of America Abstracts with Program 22(7). (communicated by William I. Ausich)

Ausich, W.I. Regional encrinites: How can 5 X 10^9 M^3 of crinoidal limestone be accummulated?

Baumiller, T.K., and M. LaBarbera. In situ and laboratory experiments and observations of the isocrinid Endoxocrinus parrae: Implications to the functional morphology and ecology of Paleozoic crinoids.

Bodenbender, B.E. Potential of skeletal crystallography as a phylogenetic tool in edrioasteroids.

Foote, M. Morphologic versus taxonomic diversity in a clade's history. [concerns blastoids]

Frederick, D.L., J.R. Byran, and T.W. Broadhead. Ontogenetic shape determination in Eucalyptocrinites: Implications for functional morphology and taxonomy.

Greenstein, B.J. Predictability of taphonomic bias and the echinoid fossil record.

Guensburg, T.E., and J. Sprinkle. Early Ordovician crinoid-dominated echinoderm fauna from the Fillmore Formation of western Utah.

Jablonski, D., and A.B. Smith. Ecology and phylogeny: Environmental patterns in the evolution of the echinoid order Salenioida.

Llewellyn, G, and D.L. Meyer. Paleoecological implications of the biotic associates of reef dwelling caribbean comatulid crinoids.

Schubert, J.K., and D.J. Bottjer. Paleoecology of the oldest known articulate crinoid.

Sprinkle, J. New echinoderm fauna from the Ninemile Shale (Lower Ordovician) of central and southern Nevada.

Sumrall, C.D., and J. Sprinkle. "Blisters, "stuffers", and "stalkers" -- basic designs in late Paleozoic edrioasteroids.

Sutter, S.J. Cladistic relationships of living cassiduloids: Phylogenetic reconstruction of a severely thinned clade.

1991 JOINT MEETING OF THE NORTHEASTERN AND SOUTHEASTERN SECTIONS OF THE GEOLOGICAL SOCIETY OF AMERICA BALTIMORE, MARYLAND, March 14-16, 1991. Geological Society of America Abstracts with Program 23(1). (communicated by William I. Ausich)

Brower, J.C. The life and times of Ectenocrinus simplex, an Ordovician crinoid.

Taylor, W.L., and D.E. Brett. The Homocrinus beds: Obrution Lagerstatten from the Silurian (Wenlockian) of western New York.

1991 NORTH-CENTRAL SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA TOLEDO, OHIO, April 18 to 19, Geological Society of America Abstracts with Program 23(3). (communicated by William I. Ausich)

Baumiller, T.K., and W.I. Ausich. The "broken stick" model: A null hypothesis for crinoid stalk taphonomy.

Donovan, S.K. The crinoid Xenocrinus as a key element of the Hirnantia fauna.

Greenstein, B.J. Taphonomic bias and the evolutionary history of the family Cidaridae: A comparative approach.

Holterhoff, P.F., and R.K. Padian. Generic reorganization and replacement of crinoids through the Ervine Creek -- Cruzon interval (Upper Pennsylvanian, Virgilian) of S.E. Nebraska and S.W. Iowa.

ECHINODERMALOGISTS BRING HOME THE BRASS RING (CANAL)
(communicated by William I. Ausich)

The Paleontological Society presents annually the Schuchert Award to recognize excellence and promise in a paleontologist under the age of 40. Two echinodermalogists, William I. Ausich and Carlton E. Brett, received the 1990 Schuchert Award. The award ceremony was held at the annual luncheon of the Paleontological Society during the 1990 Annual Meeting of the Geological Society of America (Dallas, Texas). These awards will help to counterbalance the predominance of mollusc workers who have received this award. Other echinoderm specialists to receive this award are James Sprinkle and David Jablonski (also works on mollsucs).

THESES AND DISSERTATIONS

HONORS THESES

Japan

Ogura, M., H. Yokochi, A. Ueno, M. Takadam, N. Teruya, A. Nagano, U. Fujimaka, Y. Shimoto. 1982. Study on crown-of-thorns starfish in the northwestern region of Iriomote Island. Tokai Univ.

Ohtaki, T., T. Toyoguchi. 1986. Tolerances of A. planci against water temperatures, lowered salinities and lowered levels of dissolved oxygen. Tokai Univ.

Sugiyama, K. Tou. 1986. Ecological studies on juveniles of A.planci at Iriomote Island: distribution, morphogenesis and change in feeding habity, and tolerance against environmental stresses. Tokai Univ.

Takahashi. N. 1986. Tolerance and reactions of Acanthaster planci against lowered temperatures. Univ. of Ryukyus.

Ueno, A. 1986. A study of crown-of-thorns starfish in the northwestern part ofIriomote Island. Tokai Univ.

Australia

Laegdsgaard, P. 1989. The reproduction of two co-occurring species of the sea urchin Heliocidaris in the Sydney region. Univ. of Sydney.

Canada

Ellis, C. 1987. Distribution and abundance of amoebae (Paramoeba invadens) in tissues of diseased sea urchins (Strongylocentrotus droebachiensis). Dalhousie Univ.

Hamm, J. 1987. Aggregation and cryptic behaviour in juvenile sea urchins (Strongylocen predators, food availability, and habitat complexity. Dalhousie Univ.

Pontefract, R.1989. Ecological energetics of sea urchins. Dalhousie Univ.

Ireland

Byrne, M. 1978. The phenomenon of aggregation in echinoderms with particular reference to the ophiuroid Ophiocomina nigra (Abildgaard) and the crinoid Antedon bifida (Pennant). Univ. College, Galway.

White, M. Aspects of the biology and ecology of Echinus esculentus Linnaeus (Echinoidea: Echinodermata). Univ. College, Galway.

MASTER'S THESES

Japan

Okaji, K. 1989. Delayed spawning activity and prolonged reproductive period in dispersed individuals of Acanthaster planci (L.) in Okinawa. Univ. of Ryukyus.

Australia

Fernandes, L. 1989. Biases associated with the use of manta tow, a rapid reef surveillance technique, with particular application to the Crown-of-Thorns starfish (Acanthaster planci). James Cook Univ. of North Queensland.

Nash, W.J. 1983. Population genetic and morphometric studies on the Crown-of-Thorns starfish, Acanthaster planci (L.) in the Great Barrier Reef region. James Cook Univ. of North Queensland.

South Africa

Thandar, A.S. 1971. The holothurian fauna of the rocky shores of Natal. Univ. of South Africa.

Canada

Raymond, B.G. 1986. Behaviour and growth of the early life history stages of the sea urchin, Strongylocentrotus droebachiensis. Dalhousie Univ.

Hart, M.W. 1987. Temperture and food effects on the growth and shape of an echinopluteus, Strongylocentrotus droebachiensis. Dalhousie Univ.

Dutil, C. 1988. Partage des ressources alimentaires et comportement de predation des etoiles de mer de la communaute infralittorale du golfe du Saint-Laurent. Universite Laval.

Pearse, C. 1990. Induction of settlement and metamorphosis in the echinoids, Echinarachnius parma (Lamarck) and Strongylocentrotus droebachiensis (Muller). Dalhousie Univ.

Jamaica

Sides, E.M. 1976. A study of niche separation in three species of Ophiocoma (Echinodermata: Ohiuroidea) in Jamaica. Univ. West Indies (Mona).

Gordon, C.M. 1990. Taxonomy and palaeoecology of the echinoids of the Late Pleistocene Falmouth Formation of Jamaica. Univ. West Indies (Mona).

United States

Adams, J.M. 1991. The effect of arm loss on respiration, excretion, and biomass production in Luidia clathrata (Echinodermata: Asteroidea). Univ. South Florida.

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REQUESTS AND CURRENT STUDIES

John Ogden and David Forcucci (Keys Marine Laboratory, Florida Institute of Oceanography) are assessing and monitoring the distribution, abundance, and population dynamics (including recruitment) of *Diadema antillarum* on reefs in the Florida Keys.

Richard E. Terry is studying the echinoderms from the Banff Formation (Lower Carboniferous) of Alberta, Canada. He would like to hear from anyone who has collected there or who knows of collections from the region.

A.M.C. Koros (Pittsburg) and A.L. Pulsford (Plymouth Marine Laboratory) are studying natural killer cells in sea-urchin blood. (J. Mar. Biol. Ass. U.K. 71: 934.

D.B. James (Tuticorin) and co-workers have induced Holothuria scabra to spawn in the laboratory and produced seed for ranching projects. They have also induced H. atra to spawn in the laboratory. They have conducted a training program for fishermen on improved methods of handling and processing sea cucumbers at Tirupalakudi in South India during 19-25 February in collaboration with the Marine Products Export Development Authority and the Tamil Nadu Fisheries Department.

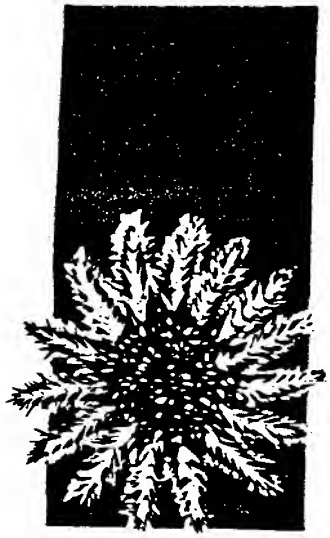
L. Campos (Oceanography, Southampton) has been studying the diet of deep-sea echinoids.

J.D. McKenzie (Dunstaffnage Marine Laboratory, Oban) has research projects on the biology of sub-cuticular bacteria of ophiuroids, neural control of the adhesion of tube-feet, and echinoderm epithelial antifouling mechanisms.

Daniel R. Norris (Univ. of Guam) is studying the ecology of the spatangoid *Maretia*.

Florence Payot (Odense Univ.)is studying heavy metals in *Asterias*.

Carlos A. Borzone (Univ. Federal Parana) is studying the biology of sand dollars.



STARFISH RESEARCH IN 1991/92

The damage to coral reefs caused by outbreaks of the crown-of-thorns starfish (COTS) is one of the most serious scientific and management issues on the Great Barrier Reef (GBR). Although there are indications that the current series of out breaks which started in 1979 is nearing an end, an estimated one-fifth of the 2900 reefs on the GBR has been affected over the last decade. Public recognition of the seriousness of the issue has been reflected in Federal Government funding for research into the starfish, causes of outbreaks and its effects on the GBR. Since 1985 the Authority has received special funding of around $6 million for COTS research.

This financial year represents the third and perhaps final year of the current COTS research program which has focused on monitoring the starfish and its effects on corals, predation on post-settlement stages of COTS, reproduction and larval dispersal. The luxury of committed, long-term (three years) funding of around A$1 million per annum from the Federal Government has meant that we have been able to concentrate on some of these more complex and costly areas of research hitherto un-investigated or under-explored.

Four major projects are continuing in 1991/92: broadscale surveys of COTS and their effects on corals along the GBR by the Australian Institute of Marine Science (AIMS); the role of predation in factors influencing the survival of small juvenile COTS cultured in the laboratory by Dr John Keesing of AIMS; feeding studies on potential fish predators of post-settlement COTS by Dr Hugh Sweatman of James Cook University (JCU); and investigation of factors affecting the reproduction and larval dispersal and nutrition of COTS by Dr Russ Babcock of AIMS.

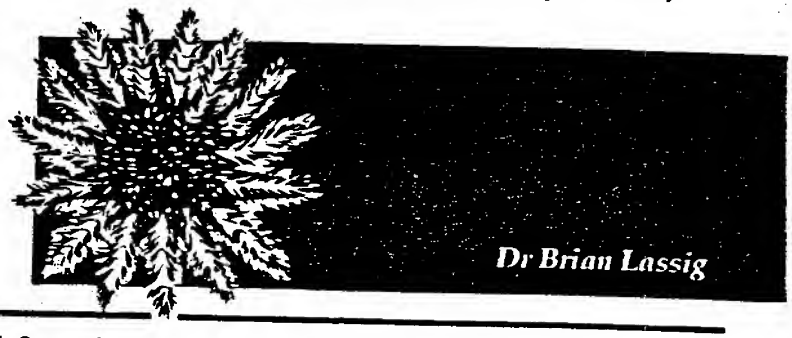
Less than 10% of the 1991/92 budget has been allocated to new projects. These include: feeding ecology of larval and pre-coral feeding juvenile COTS (Mr Ken Okaji, formerly of the University of the Ryukyus, now at AIMS); the movement of actual starfish outbreaks during the 1980s - unification of the oceanography and biology (Dr Kerry Black of the Victorian Institute of Marine Sciences); testing predictions of reef connectedness using population genetics (Dr John Benzie, AIMS); and an investigation of COTS larval dispersal - field experiments (Dr Kerry Black). The last project will be contracted only if additional funding of around $50,000 can be arranged from other sources.

A number of existing projects should be completed this financial year. These include: age determination in COTS (Assoc. Prof. John Lucas and Mr Richard Stump of JCU); impact of COTS on massive corals (Mr Lyndon DeVantier of the University of Queensland and AIMS); modelling to assess the impact of predators on COTS populations (Dr Hamish McCallum, University of Queensland and Dr Roger Bradbury of the National Resource Information Centre) and modelling approach to hydrodynamics and the large-scale larval dispersal of COTS (Marine Modelling Unit, JCU).

Thanks to the application of all researchers within the research program we know a great deal more about the biology, ecology and dispersal of the starfish than we did three years ago. Up to February this year there were 718 publications on COTS. As a spin-off from this focus on the starfish, we have also gained considerable insight into many processes and principles operating on the GBR, such as monitoring techniques, larval dispersal, reef connectedness and coral community dynamics.

While most reef-lovers will be thrilled with the declining COTS populations (according to AIMS surveys only 4% of surveyed reefs had outbreaks in 1989/90 compared with 16% in the previous year), the shortage of suitably large populations for study within easy access will be a headache for researchers in future years.

A short time ago we updated the COTS sighting form. This form was designed so that we could get necessary information on the presence or absence of COTS and status of the corals on a wide range of reefs not included in our formal annual surveys. If you plan to visit the GBR for work or pleasure, please give us a call and we'll send you some forms (the forms and their postage are free).



Dr Brian Lassig

Reef Research. 1991
vol. 1, no. 2. Great Barrier Reef
Marine Park Authority.

NEW PROJECTS IN THE CROWN-OF-THORNS STARFISH RESEARCH PROGRAM

Dr William Gladstone

An overview of the COTS program was given last issue and details of some of the new projects commencing this year are:

HYDRODYNAMIC MODEL TESTING

An oceanographic model to explain the spread of crown-of-thorns starfish (*Acanthaster planci*) outbreaks was developed by researchers from James Cook University (JCU) (Ian Dight, Maurice James and Lance Bode) in the current crown-of-thorns starfish research program. The so-called 'sink-source' model predicts patterns of connectivity among reefs based on larval transport by currents.

Some of the predictions of the sink-source model will be tested by Dr John Benzie of Australian Institute of Marine Science (AIMS) using estimates of gene flow among reefs. Theoretically, the degree of genetic homogeneity among populations on sink and source reefs should be higher than for less well connected populations.

Gene frequencies will be estimated from either protein electrophoresis or mitochondrial DNA (mDNA). Crown-of-thorns starfish have proved difficult animals for mDNA techniques so John will use the blue starfish *Linckia* as a model for crown-of-thorns starfish. *Linckia* has a similar larval duration and morphology as *A. planci* and so should be an adequate model.

Some of the questions to be addressed are:

(1) Are some reefs more closely connected biologically than others?

(2) Are sets of closely connected reefs highly or completely isolated from other such sets implying they be treated as separate systems, or is there sufficient gene flow implying reasonable biological exchange among such sets to allow them to be treated as one larger system for management purposes?

(3) To what extent do present oceanographic processes control the biological relationships among reefs?

STARFISH LARVAE: IDENTIFICATION AND CAPTURE

The ecology of the very early life history of *A. planci*, from their time as planktonic larvae to settlement, is important in understanding the spread and causes of outbreaks. Progress in this area has been hindered by difficulties in collecting larvae or newly settled starfish, and their identification since most starfish larvae look similar.

The objectives of Ms Katrina Roper's (Zoology, JCU, in collaboration with Deakin University)

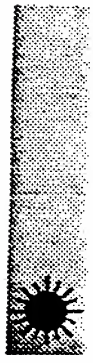
PhD research are:

(1) to further the cross-screening of existing monoclonal antibodies and to develop more monoclonal antibodies against several species of starfish as a method of identifying the larvae

(2) to develop and trial methods of collecting plankton samples in and around reef systems with the aim of obtaining 'wild' asteroid larvae

(3) to use the collection devices in conjunction with a specific identification system to study the temporal and spatial dispersal patterns of COTS.

In his recent review of the COTS research program Dr Bob Johannes (CSIRO) highlighted the potential for techniques developed in this project to contribute to many other areas of marine research such as fisheries population biology.

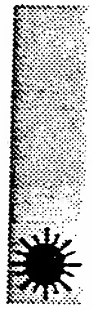


THE MOVEMENT OF ACTUAL STARFISH OUTBREAKS DURING THE 1980's - UNIFICATION OF THE OCEANOGRAPHY AND BIOLOGY

Dr Kerry Black's (Victorian Institute of Marine Science) research in the COTS research program has been concerned with explaining the spread of outbreaks. He has conducted field experiments on circulation around individual reefs and developed validated numerical simulations of circulation, dispersal and retention cells around clusters of reefs. He has also hindcast, using tidal constants, longshore currents in the central GBR for the last 25 years.

Kerry is now combining this data with data collected and analyzed by Dr Peter Moran (AIMS) and Mr Glenn De'Ath (JCU) on the locations, intensity, and spread of movement of *A. planci* outbreaks during the 1980's.

The aim of the project is to model the movement of COTS outbreak migration during the 1980's in the Cairns and Central Sections of the Great Barrier Reef Marine Park using computer simulations of larval dispersal driven by real winds and currents.



ASSESSING THE ROLE OF DISSOLVED ORGANIC MATTER AND BACTERIA IN THE NUTRITION AND ENERGETICS OF *Acanthaster planci* LARVAE

A. planci outbreaks could be the result of massive settlement events following improved larval survival. Increased food availability (in the form of Dissolved Organic Matter (DOM), bacteria, or phytoplankon) resulting from enrichment of reef waters by nitrogen, phosphorus and organic compounds is a possible mechanism.

The objective of this project is to evaluate the importance of DOM and bacteria as nutritional sources for *A. planci* larvae. The research will be undertaken by T Ayukai (AIMS), O Hoegh-Guldberg (University of Southern California, University of Sydney from 1992) and J Welborn (University of Southern California). They plan to measure DOM uptake, bacterivory and energy requirements of *A. planci* larvae and ambient levels of DOM and bacteria.

The study will be done in five parts:

(1) DOM uptake by *A. planci* larvae

(2) Bacterivory by *A. planci* larvae

(3) Energy requirements of *A. planci* larvae

(4) Cross-shelf variation in DOM levels

(5) Cross-shelf variation in bacterial abundance

PhD research by Mr Ken Okaji (AIMS) on nutrition of the early life stages of *A. planci* is also being funded; details of the project will be given in a future issue of Reef Research.

MODIFICATIONS TO THE BULLETIN "ČASOPIS NÁRODNÍHO MUZEA v PRAZE, ŘADA PŘÍRODOVĚDNÁ": DATES OF ISSUE OF INDIVIDUAL NUMBERS/VOLUMES CXXXVI – CLVII

The "Časopis Národního muzea" ("Bulletin of the National Museum") is the oldest Czech scientific periodical, the first volume being issued in 1827. Since 1918 it has been divided into two series, Historical Sciences and Natural History. The Natural History Series ("řada přírodovědná") publishes results of research and activities of the Natural History departments of the National Museum (Mineralogy and Petrology, Palaeontology, Mycology, Botany, Entomology, Zoology, Anthropology, Chemical Research Division). (In 1964 these departments were combined to form the Natural History Museum, as a part of the National Museum of Prague.) The Bulletin also publishes special and scientific papers from outside authors, provided that the subject is based on or connected with the Museum's collections.

From Vol. CLVIII (incl.) the Bulletin adopts the arrangement common abroad in presenting abstracts, keywords, dates of presentation and issue, addresses of authors, etc. The proportion of foreign language content, predominantly English, has been greatly increased.

Due to technical problems of publication there were, during the last 25 years, irregularities in the dates of issue of some numbers of the Bulletin. The relative numbers, pages and dates of issue of each Volume are given below.

Volume	Year	Number	Pages	Date of issue	
CXXXVI	1967	1	1–56	April	1967
		2	57–120	June	1967
		3	121–168	August	1967
		4	169–240	November	1967
CXXXVII	1968	1–2	1–120	April	1969
CXXXVIII	1969	3–4	1–120	September	1970
CXXXIX	1970	1–4	1–159	January	1975
CXL	1971	1–2	1–120	December	1971
		3–4	121–240	June	1972
CXLI	1972	1–2	1–120	December	1972
		3–4	121–240	February	1974
CXLII	1973	1–4	1–120	December	1975
CXLIII	1974	1–2	1–52	September	1976
		3–4	53–124	June	1977
CXLIV	1975	1–4	1–120	December	1977
CXLV	1976	1	1–56	April	1977
		2	57–120	May	1977
		3	121–184	May	1978
		4	185–240	June	1978
CXLVI	1977	1–4	1–232	March	1979
CXLVII	1978	1–4	1–147	October	1980
CXLVIII	1979	1	1–68	October	1979
		2	69–140	April	1980
		3–4	141–240	October	1980
CXLIX	1980	1–2	1–124	June	1981
		3–4	125–240	December	1981
CL	1981	1–2	1–120	December	1981
		3–4	121–240	April	1982
CLI	1982	1	1–60	May	1982
		2	61–120	June	1982
		3	121–184	November	1982
		4	185–240	February	1983
CLII	1983	1	1–60	May	1983
		2	61–120	August	1983
		3	121–180	November	1983
		4	181–244	February	1984
CLIII	1984	1	1–60	June	1984
		2	61–120	October	1984
		3	121–184	December	1985
		4	185–240	August	1986
CLIV	1985	1	1–56	August	1986
		2	57–116	September	1988
		3–4	117–228	March	1989
CLV	1986	1–2	1–92	June	1989
		3–4	93–244	April	1990
CLVI	1987	1–4	1–184	July	1991
CLVII	1988	1–4	1–228	November	1991

1991

Sea urchin deaths puzzle scientists

Experts say die-off in the Keys is allowing a dense proliferation of damaging algae on the coral reefs.

KEY WEST (AP) -- Prickly black sea urchins, an ornery creature crucial to the health of Florida Keys coral reefs, are dying off by the dozens, but scientists can't say why.

The urchins, Diadema antillarum, are a common site for snorkelers who see long black spines and the pincushion base sheltered in coral crevices.

But on Middle Sambo Reef last spring, they quickly died off. More than 300 could be counted in one section on the reef south of Key West in March, but only a dozen were left in June.

The epidemic has marine biologists puzzled. Scientists researching the mass illness assume it is caused by bacteria or a virus, but the invader has never been identified.

No correlation has been found between the outbreaks and times of the year, weather conditions or temperature, and only one kind of urchin is affected.

The first large-scale attack was reported in 1983 near the Panama Canal and followed ocean currents. In two years, whole populations of the urchins disappeared across the Caribbean.

The speedy deaths are no surprise to John Ogden, director of the Florida Institute of Oceanography in St. Petersburg.

"During the mass mortality, on any one reef, it took no more than four days for all of the urchins to die," he said.

After the 1983 epidemic, the sea urchins made a slow return. But Keys colonies had reached only about 10 percent of their old numbers when the urchins were affected again.

Grady Sullivan, a tropical fish collector from Big Pine Key, noticed a patch of dying urchins last spring near Key West. Craig Quirolo, executive director of Reef Relief, examined another group of dying animals nearby.

Dave Forcucci of the Florida Institute of Oceanography began the research that detected the rapid massacre at Middle Sambo Reef.

Urchins have been affected mainly off Key West and in a section of Biscayne National Park south of Miami.

As the sea animal sickens, its spines bunch up, leaving parts of the body shell exposed. The spines droop and then fall off just before death.

The urchins are valuable because they scrape algae off coral with their hard mouth on the pincushion bottom.

"It's the only bare-rock inhabiting, mobile-grazing urchin in the Caribbean," said Ogden.

He believes the die-off in the Keys has allowed an unnaturally dense proliferation of damaging algae on the reefs.

Key Largo National Marine Sanctuary biologist Harold Hudson noted the reef's health is tied to the urchin.

"They're absolutely critical to maintaining the coral algae balance," he said. "They literally keep the algae crop back so it doesn't overgrow the reef."

Parrotfish are the only other algae grazers on the reef, but they are overfished.

Forcucci is sending samples of dead urchins to three laboratories for analysis.

But researchers must overcome the unpopular stature of the urchins, who are perhaps best known by swimmers in pain from their encounters.

"We wrote to the Azores to see if the urchins had died off there," Ogden said. "One woman wrote back, 'Regrettably, no.'"

STARFISH MASS MORTALITY IN THE WHITE SEA Communicated by V. Kasyanov.

NO ANSWER TO THE ENIGMA....

An attempt to elucidte the cause of mass death of starfishes in Dvinskaya Guba Inlet of the White Sea has failed.

The joint committee established under the aegis of the Council of Ministers of the USSR and the USSR Academy of Sciences was a failure. The scientists have rejected the version of increased radiation and poisoning of the waters in the inlet by components of the rocket fuel released by the submarine lost in December 1989. But the accounts of old residents seem to be confirmed: in the 50s, containers with yperite were sunk in the White Sea.

Another group of scientists and specialists arrived from Moscow. Probably they will succeed in unraveling the mystery of this ecological disaster which is spreading even wider.

Victor Friedman from Arkhangelsk. "Izvestia". 12 July 1990.
communicated by V. Kasyanov

ИСКЛЮЧИЛИ ИЗ ПАРТИИ

Сотрудники Минераловодского городского отдела КГБ на партийном собрании исключили из рядов КПСС своего начальника

За что держал ответ перед коммунистами начальник отдела полковник госбезопасности Е. Тимишев? Как мне рассказали в горкоме КПСС, за злоупотребление служебным положением, нарушение партийной морали. Добившись выделения для него просторного коттеджа, он не освободил прежнюю квартиру, оставил там одного из членов семьи. А в новый дом, чтобы «прикрыть» излишнюю жилую площадь, прописал родителей, тоже не бедствовавших без жилья. Такой поступок руководителя не мог вызвать одобрения. Попытка коммунистов КГБ повлиять на старшего товарища ни к чему не привела. Тогда-то и состоялось партийное собрание, его суровое решение было единогласным.

Виктор ФРИДМАН—из Архангельска.

THE SEA STARS ARE DYING" WHY?

It has been recently reported in the press of a mysterious ecological disaster on the White Sea. Some 40 km of the southern coast of Dvinskaya Guba Inlet became a "cemetary" of sea stars and crabs. The density of congestions of dead animals has reached 300 specimens per square meter for sea stars and 17 specimens for crabs. In the beginning of June, more than 50 dead bodies of seals were found on the shores. An anomalous behavior of some seals was noted: cramps and flabbiness. Similar symptons were noted somewhat later also in animals of Kandalakshsky Zaliv Bay. The service of nature conservation in Arkhangelsk was alarmed, and a special commission of the RSFSR Soviet of Ministers has been established.

The alarm signal was also received in the Belomar Biological Field Station of the Academy of Sciences of the USSR (Leningrad). From there, a research vessel KARTESH sailed to the region of the disaster. Doctor of Biological Sciences Victor Berger, Direction of the Station, reported to Leningrad: a long-lasting storm prevented survey of the shore in the epicenter of the

disaster, but the layer of dead sea stars washed onto the shore was as thick as 15 cm even in outlying areas. "There are no youngsters among the dead animals, the minimal size being 5-6 cm, 10-12 cm on the average. It seems possible that starfishes and crabs inhabiting the depths of 5-6 m along the shores lose their activity under some chemical effect and may undergo necrosis. No longer able to attach to the substratum, the sea stars are washed ashore by tides. It is very suspicious that we observe the phenomenon in the inner waters of Dvinskaya Guba Inlet".

It is estimated by the specialists that over 4 million starfishe cover the sand beach. But nobody knows how many of them are lying on the bottom: the next expedition including divers is expected to reveal the scale of the disaster. No natural causes of death have been found yet. Hence, they might be poisoned by somebody. Who could do it? And what is the poison? The following investigation looks very much like a detective story. Sea stars, bottom sediments, water, and plankton were sampled for a thorough analysis, also for fuel components; the samples were transported to Leningrad. A representative of the North Fleet has confirmed: the submarine that sank in December 1989 had to pour out about 20 tons of fuel. But the accident took place in the open sea, while the animals perished in the area reached by industrial runoffs from Arkhangelsk and Severodvinsk. The concentration of heavy metals in water samples appeared to be normal. What other cause can be involved? Pesticides, DDT, or other hazardous organic compounds? The analylsis may give the answer but will not help anyway...

In this connection, I recollect my meeting seveveral years ago Orest Scarlato, Corresponding Member of the USSR Academy of Sciences and the Director of the Zoological Institute in Leningrad. He spoke about the prospects of the development of mariculture in the White Sea. The Zoological Institute provided scientific support in restoration of supplies of the well-known White Sea herring and in establishment of trout farms. The first plantations of mussels, the edible bivalve molluscs, were then also laid. Nearly 200 tons of mussels are harvested now every fourth year from one hectare of the experimental plantation, this amount giving no less than 20 tons of delicious seafood. Scarlato is a scientific leader of the project of the State Committee for Science and Technology "The White Sea", aimed at obtaining maximum volume of useful biological product from the ocean. Although nobody had ever made an attempt to culture mussels in such a severe environment, Dr. Scarlato noted the waters of the White Sea were fortunately clear, and secondly, shallow waters where molluscs grow are well heated in summer while tide and wave action provides planton, the food supply for mussel culture. Evidently the northern winter, which covers the water with ice, makes certain problems, but specialists of the Institute have succeeded in culturing mussles even under the ice.

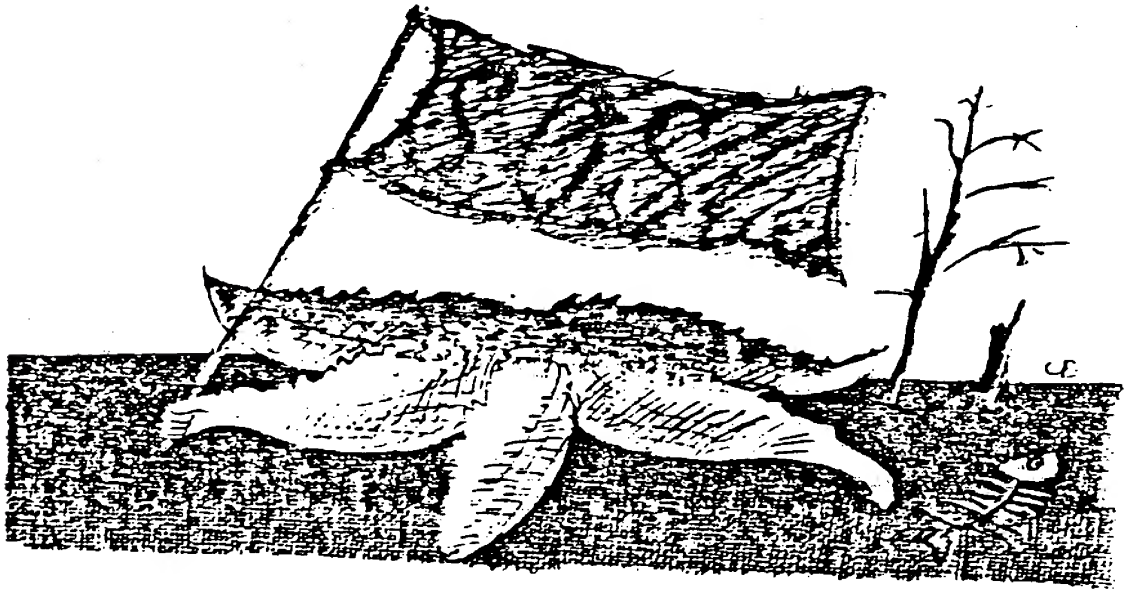
But there occurred the ecological accident. Should it drastically change the optimistic plans? Dr. Scarlato shrugged his shoulders: "I can repeat even now that the White Sea is the only relatively clean sea in the European part of the country. It is the first time that we have come across an 'experiment' of poisoning sea inhabitants and we are able to observe *nolens volens* the consequence of this poisoning. Starfish (and crabs also) are predators and annihilate many valuable molluscs, including also the cultured mussels. But it is reported that forcible annihilation of starfish within marine communities results in serious changes of the entire biocoenosis. Fortunately, there are no mussel plantations in Dvinskaya Guba Inlet. But we are about to establish plantations all along the coasts. Without clean waters, mariculture is impossible. Therefore, we need a strict control of all potential sources of pollution and improved work of runoff-clearing system on large works".

"We do our best for the protection of sea waters", adds the Scientific Secretary of the project "The White Sea", Candidate of Biological Sciences Valentina Kulachkova. "We have a steady contact with representatives of the Northern Fleet and the sea oil-transport service. But it is evident that our attempts are unsuccessful. A special governmental decree on conservation of the White Sea is badly needed. We are trying to prepare a project of the conservation decree by this autumn to submit to the Supreme Soviet of the USSR."

Arkady Sosnov, special correspondent. "Poisk". 1990. No. 26:8.
communicated by V. Kasyanov.

ПОДРОБНОСТИ ДЛЯ «ПОИСКА»

Отчего погибают звезды...



В прессе уже сообщалось о загадочной экологической катастрофе на Белом море. Вдоль южного берега Двинского залива на протяжении около 40 км обнаружено „кладбище" морских звезд и крабов. Плотность погибших звезд достигает 300 особей на квадратный метр, крабов – 17. В начале июня на берегу появились туши мертвых тюленей – их найдено свыше 50. Отмечено аномальное поведение некоторых тюленей: судороги, вялость. Причем животных с аналогичными симптомами наблюдались после этого и в Кандалакшском заливе. На ноги были подняты природоохранные службы Архангельска, создана специальная комиссия Совмина РСФСР.

Сигнал тревоги поступил и на Беломорскую биостанцию Зоологического института АН СССР. Оттуда в район гибели животных направилось научно-исследовательское судно „Картеш". Заведующий станцией доктор биологических наук Виктор Бергер сообщил в Ленинград: затяжной шторм помешал обследовать побережье в эпицентре беды, но и на ее „периферии" слой выброшенных звезд составляет 15 сантиметров. „Среди звезд практически нет молоди, минимальный размер – 5–6, в среднем – 10–12 сантиметров. Думается, звезды и крабы, обитающие вдоль берега на глубинах 5–10 метров, под влиянием какой-то „химии" теряют активность и, может быть, наркотизируются. Звезды утратив способность присасываться, выбрасываются прибоем на берег. Очень подозрительно, что это происходит во внутренних водах Двинского залива..."

Всего, по оценкам специалистов, более 4 миллионов звезд устилают песчаный берег. Но еще неизвестно, сколько лежит на дне, – выяснить это предстоит следующей экспедиции, в составе которой будут аквалангисты. Естественных причин гибели животных не установлено. Значит, кто-то отравил их. Кто и чем? Дальнейшее расследование напоминает детектив. Пробы звезд, грунта, воды, планктона были переданы в Ленинград для анализа, в том числе и на содержание компонентов топлива. Представитель Северного флота подтвердил: в декабре прошлого года в аварийной ситуации атомная подводка вынуждена была слить около 20 тонн топлива. Но это случилось в открытой части моря. А животные погибли в том месте, куда Двина „доставляет" стоки предприятий Архангельска и Северодвинска. Концентрация тяжелых металлов в пробах воды оказалась в норме. Что остается? Пестициды, дусты, иная вредная органика? Вероятно, анализы покажут, но в конце концов от этого не легче...

Помню, как несколько лет назад директор Зоологического института член-корреспондент АН СССР Орест Скарлато делился со мной планами развития марикультуры на Белом море. Под научным руководством его института началось восстановление запасов знаменитой беломорской сельди и создание форелевых хозяйств, были заложены первые плантации двустворчатых моллюсков – мидий. С каждого гектара опытных плантаций раз в четыре года снимают до 200 тонн свежей мидии, а это не менее 20 тонн деликатесного мяса. Скарлато – научный руководитель проекта ГКНТ „Белое море", цель которого – получать с голубой нивы максимум полезной биологической продукции. Правда, в столь суровых условиях никто еще мидий не выращивал, но, во-первых, объяснял Орест Александрович, вода в Белом море достаточно чистая (!). Во-вторых, мелководья, где обитают моллюски, летом прогреваются, а чередующиеся приливы и отливы обеспечивают постоянное пополнение кормовой базы мидий – планктона. Конечно, северная зима, сковывающая акваторию ледяным панцирем, приносит немало проблем, но специалисты ЗИНа научились выращивать мидии и подо льдом.

И вот – экологическое ЧП. Не придется ли теперь в корне менять эти радужные планы? Ученый лишь развел руками:

– Я и сейчас могу повторить, что Белое море – последнее относительно чистое море в европейской части страны. Впервые столкнувшись с подобным „экспериментом" по отравлению его обитателей, мы поневоле должны будем наблюдать последствия. Звезда (как и крабы) – хищник, поедает много ценного моллюска, в том числе мидий, которых мы разводим. Но, по литературным данным, если из сообщества животных насильственно изъять звезду, происходят серьезные изменения во всем биоценозе. К счастью, в Двинском заливе мидиевых плантаций нет. Но мы-то ведь намерены расположить плантации моллюсков и рыбоводные хозяйства вдоль всего побережья. А без чистой воды марикультуры быть не может. Поэтому надо взять под строжайший контроль потенциальные источники загрязнения, наладить работу очистных сооружений прежде всего на крупных предприятиях.

– Мы делаем все, что в наших силах, для охраны вод, – дополняет ученый секретарь проекта „Белое море" кандидат биологических наук Валентина Кулачкова. – Постоянно контактируем с представителями Северного флота, с транспортниками, которые перевозят морем нефть. Но чувствуем: только наших усилий явно недостаточно. Крайне необходимо специальное правительственное постановление об охране Белого моря. Надеемся к осени подготовить проект такого постановления и выйти с ним в Верховный Совет страны.

Аркадий СОСНОВ.
(Наш соб. корр.).

DIRECTORY OF THE BRITISH MARINE FAUNA AND FLORA.

"The Species Directory" was first published, in 1987, by the Marine Conservation Society, supported by British Petroleum and the World Wildlife Fund. The directory is a computer-based checklist of the marine fauna and flora of the British Isles and its surrounding seas (see map), and currently comprises 24 major taxa. It has been edited by Christine Howson and has drawn together a wide body of expertise with substantial contributions from over twenty taxonomists.

The Directory is an up-to-date taxonomic checklist, listing scientific names and authorities with taxonomic or distribution comments where relevant. A restricted synonymy has been given in some cases, in particular where the nomenclature in standard identification works is out of date. Each section consists of a short introduction setting the phylum in taxonomic context, a classification table to serve as a brief taxonomic index to the group, the annotated list and a bibliography. An overall introduction gives the background and rationale of the project, and the entire checklist - over 12,100 entries - is included in one alphabetic index.

The need for such a reference list had been seen for some time, particularly with the current proliferation of computer data bases. The Species Directory, therefore, brings together into one volume the various disparate lists of British marine species, incorporating recent literature, taxonomic revisions and records from individuals. It aims to standardise the nomenclature as far as possible.

A taxonomic list will never be entirely up to date, by the very nature of the subject. This means that the present version must be considered provisional. An initial 120 copies were produced, half of which were distributed to those who had contributed. The remaining copies were made available through the Marine Conservation Society at £25.00 each. These were all quickly snapped up, and this version is no longer available. A major revision is presently underway in consultation with taxonomists and other users of the present version. In this revised edition it is hoped to incorporate additional phyla and to rectify errors which have come to light since the original publication. The new version is due for publication in 1992, and will be widely available in two versions: (1) the annotated printed list, and (2) the computer coded version on 3.5 and 5.25 inch floppy discs.

Request for assistance

1. Realising that the field of taxonomy and synonymy is in a state of continual change, I hope to ensure, nevertheless, that the revised "Species Directory" will be as up to date as possible. However, it is simply not possible for me on my own to keep track of all the taxonomic literature across so many fields. I would, therefore, be very grateful for help, such as letting me know of taxonomic revisions, new records, new species in your field, either by sending actual reprints or references enabling me to trace the publication. In addition, any recomendations from users on how the present directory might be improved or made more useful would be much appreciated. All help will be fully acknowledged.

2. If there is anyone out there who would like to contribute to the project by compiling, checking or commenting on particular lists, especially ones not yet included, please contact me as soon as possible:

Brendan Ball, Department of Botany and Zoology, Ulster Museum, Botanic Gardens, Belfast BT9 5AB, Northern Ireland.

AILSA'S SECTION

I started *Ailsa's section* a number of years ago when Ailsa Clark wrote me after the first issue I edited appeared. She wrote that the newsletter was all very nice and informative, but rather dull. "Not a recipe for sea-urchin eggs or anything". She was quite right, as usual. Thus Ailsa's section is designed to present that other aspect of echinoderm studies.

ECHINODERMS IN PAINTING

"Ceres und die vier Elemente"
H. Van Balen (1575-1532) and J.Brueheld. (1568-1625). The Vienna Museum of Art. (shows asteroids)

ECHINODERMS IN LITERATURE

"Once at the beach I saw Maoris eating sea eggs raw."
Bruce Stewart. 1989 Tama and other stories.

"'I haven't got a hanky,' she said; 'I want one badly, too'. Rags dipped into his sailor blouse and brought up a very wet-looking one, knotted together. "Be very careful,' he warned her. 'Only use that corner. Don't undo it. I've got a little starfish inside I'm going to tame'."
Katherine Mansfield. 1922. At the Bay.

"'Horseshit', said the party balloon. She began to breath more noisily through her nose, and she stirred in the chair. Her eyes dulled like the surface of a pond beneath a breeze, and her shoulders settled. Her expression was for a moment surprised as she felt the change spreading from within the new imperative. Her hands spread out like a starfish, and despite herself she began to cry."
Owen Marshall. 1982. The day Hemingway died.

"Because I had never stopped to think that man, a creature obviously less rudimentary in structure than the sea-urchin or even the whale, is nevertheless still unprovided a certain number of essential organs, and notably posses none that will serve for kissing."
M. Proust The Germantis Way, tr. C.K. Scott Montcrief. (in the thesis of M. White).

"The menu, based on oysters and lobsters in general, has already been arranged by Genevieve -- and the wines too -- by telephone. The sea urchins are opened in front of our eyes by two waiters and I am a little absent-minded because embarrassed: Genevieve inspires in me fear and reverance."
Aldo Bussi. 1988. Seminar on Youth.

ECHINODERMS IN POETRY

Justement l'heure sonnait onze
cinq brasses sous la surface
perches mules sargues passent
avec d'enormes ouies et courtes queues troussees en poupe

En montant j'ai rencontre des eponges
des etoiles de mer
et de freles anemones taciturnes
et plus haut vers l'oree lippue de l'eau
des patelles couleur d'eglantines

from: Odysseus Elytis by Adion Esti.
Translated from the Greek by Xavier Bordes and Robert Languenalli.

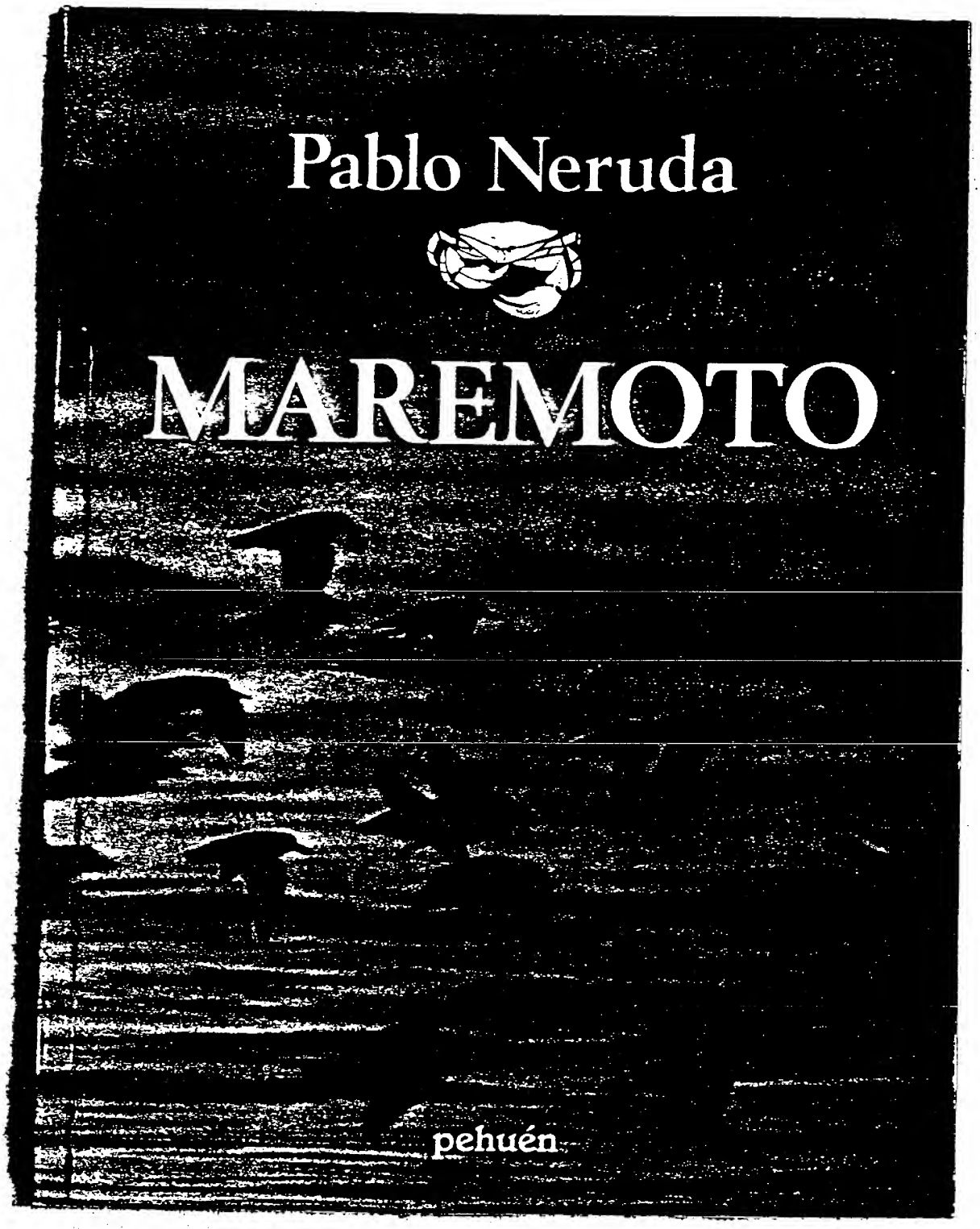
Spindrift
On this tree thrown up
From the sea, its tangle of roots
Letting the wind go through, I sit
Looking down the beach: old
Horseshoe crabs, broken skates,
Sand dollars, sea horses, as though
Only primeval creatures get destroyed,
At chunks of sea-mud still quivering,
At the light as it glints off the water
And the billion facets of the sand,
At the soft, mystical shine the wind
Blows over the dunes as they creep.

From: Kinnell, Galway. 1964. Flower Herding on Mount Monadnock.

Daybreak
On the tidal mud, just before sunset,
dozens of starfishes
were creeping. It was
as though the mud were a sky
and enormous, imperfect stars
moved across it as slowly
as the actual stars corss heaven.
All at once they stopped,
and as if they had simply
increased their receptivity
to gravity they sank down
into the mud; they faded down
into it and lay still; and by the time
pink of sunset broke across them
they were as invisible
as the true stars at daybreak.

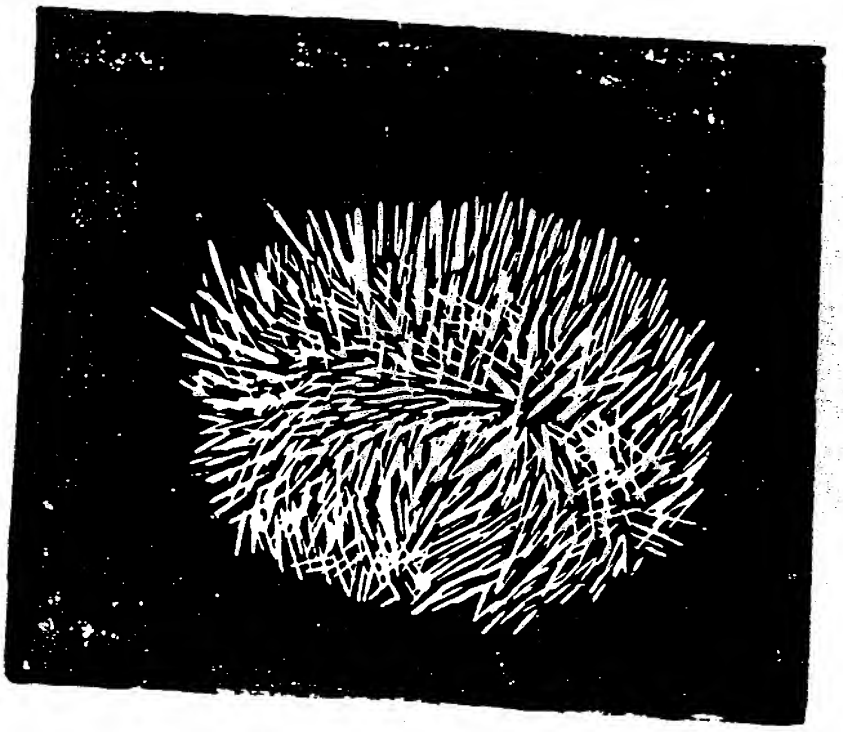
From: Kinnell, Galway. 1980. Mortal Acts, Mortal Words.

Communicated by M. Rearick



Communicated by
JAMES McCLINTOCK

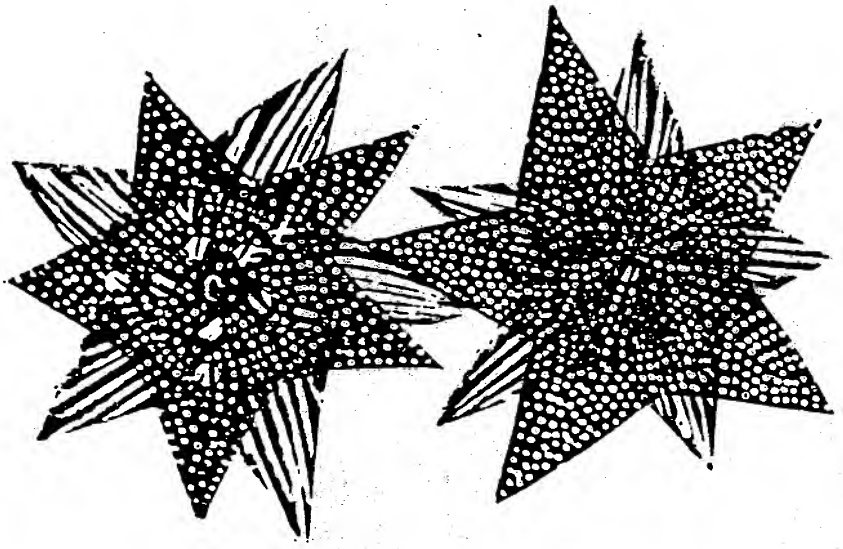
ERIZO



El Erizo es el sol del mar,
centrífugo y anaranjado,
lleno de púas como llamas,
hecho de huevos y de yodo.

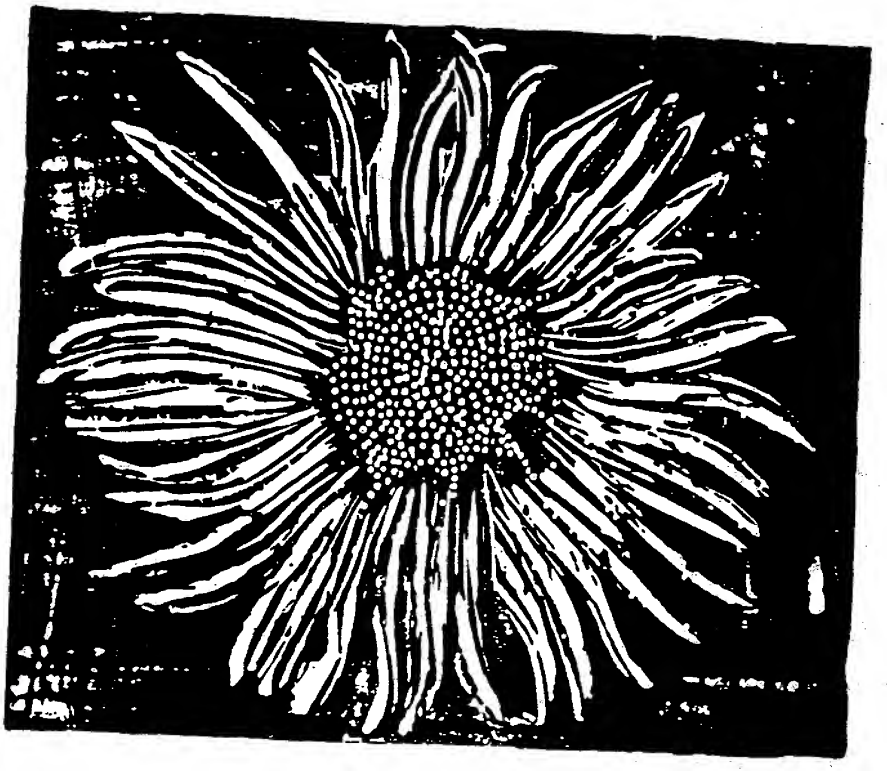
El Erizo es como el mundo:
redondo, frágil, escondido:
húmedo, secreto y hostil:
el Erizo es como el amor.

ESTRELLAS



Cuando en el cielo las estrellas
desestiman el firmamento
y se van a dormir de día,
las estrellas de agua saludan
al cielo enterrado en el mar
inaugurando los deberes
del nuevo cielo submarino.

SOL DE MAR



Yo encontré en Isla Negra un día
un sol acostado en la arena,
un sol centrífugo y central
cubierto de dedos de oro
y ventosas como alfileres.

Recogí el sol enarenado
y levantándolo a la luz
lo comparé con el del cielo.

No se miraron ni se vieron.

SEA URCHIN

THE SEA URCHIN IS THE SUN OF THE SEA,
CENTRIFUGAL AND ORANGE,
FULL OF SPINES LIKE FLAMES,
MADE OF EGGS AND OF IODINE.

THE SEA URCHIN IS LIKE THE WORLD:
ROUND, FRAGILE, HIDDEN:
MOIST, SECRETIVE AND HOSTILE:
THE SEA URCHIN IS LIKE LOVE.

SEA STARS

WHEN IN THE SKY STARS
DISREGARD THE FIRMAMENT
AND RETIRE TO SLEEP AT DAY,
THE STARS OF THE SEA GREET
THE SKY BURIED IN THE SEA
UNVEILING THE DUTIES
OF THE NEW SUBMARINE SKY.

SUN OF SEA

I FOUND IN ISLA NEGRA ONE DAY
A SUN LAYING ON THE SAND,
A CENTRIFUGAL AND CENTRAL SUN
COVERED WITH FINGERS OF GOLD
AND TUBE FEET LIKE NEEDLES.

I PICKED UP THE SAND-COVERED SUN
AND LIFTING IT TO THE LIGHT
I COMPARED IT WITH THE ONE IN THE SKY.

THEY NEITHER LOOK NOR SAW EACH OTHER.

TRANSLATION: ROBERTO LLANSÓ

HOPKINS MARINE STATION
Centennial Year

Hopkins Marine Station of Stanford University was founded in 1892 and will be celebrating the event 29-30 August 1992. For information, telephone Mark Denny: (408) 655-6207.

VIVIPARARITY AND ASEXUAL REPRODUCTION

"In the lagoon inside the coral reef at Cannoniers Point, Mauritius, wide areas of very sahllow depth, lying dry at low tide, are covered by small green algae...; the specimens living in this carpet are thus not in danger of drying up during low tide. In this carpet a characteristic biocoenoces is found..., and three species of small Ophiurids, two of the *Amphipholis squamata* and the *Ophionereis vivipara*... being viviparous, the third *Amphiodia dividua*, propagating through autotomy. It lies at hand to suggest that the peculiar habitat of these Ophiurids has some connection with their mode of propagation." T. Mortensen. 1932-1933. Vidensk. Meddel. Dansk naturhist. For. 93.

THE BIOLOGICAL STATIONS OF EUROPE

C.A. Kofoid. 1910. Bull. U.S. Bureau of Education, No. 4.

(At Naples) "Every morning at 10 o'clock the ten or more fishermen of the station, with buckets or baskets full of glass jars poised gracefully on their heads, march into the court and receiving room of the station with their prizes from the sea--scarlet starfishes, orange feather stars, red and black sea-cucumbers, sea-urchins, squirming serpent stars, and bristling purple sea-urchins..."

(At the Russian Zoological Station at Villefrance-sur-Mer) "The program of a practical course in marine zoology includes the following subjects: *Radiolaria*, fertilization and cleavage of sea urchin egg, *coelenterata*, anatomh of *Echinodermata*, *Nemertina*, *Polychaeta*, *heteropoda*, and *Tunicata*...An honorarium of 50 francs is charged to those attending the course."

"The marine equipment of the Roscoff station includes a wood cutter of 18 tons, the *Pluteus*."

"In the former series of the Royal Prussian Biological Station of Helgoland papers on ...Echinodermata have appeared."

(At the Royal Zoological Station in Triest) "The greater part of the Gulf of Trieste has a bottom of gray ooze, with an abundant fauna of... echinoderms..."

(At the Trondhjem Biological Station are found) "On these steep slopes of the fiords basket stars (*Astrophyton*), crinoids (*Antedon, Rhizocrinus*) ...

Practically all the hydroids and echinoderms known in Norwegian waters are found in Trondhejem fiord."

"The dredge (of the Biological Station of the University of Christiania) brings up an abundant fauna of echinoderms, *Asterias*, *Spatangus*, *Echinus*, *Strongylocentrotus*, holothurians, and *Antedon*."

"The great extent of the littoral zone (of the Swedish Marine Zoological Station at Kristeneberg)...brings up a relatively large proportion of larval forms of echinoderms...into the plankton. Some idea of the richness of the fauna can be gathered from the fact that about forty species of echindoerms, eleven holothurians, one crinoid, twelve starfishes, eight serpent stars, and nine sea urchins are found in the Kristeneberg area."

THE COMMESTIBLE ECHINODERM

PREHISTORIC HUMAN CONSUMPTION OF SEA URCHINS IN THE CARIBBEAN

Steiniger, F.F. 1986. Erste Ergebnisse uber Untersuchungen zu Ernahrungsstrategien des Arawaken-Siedlungsplatzes Pointe der Caille, NNW Vieus Fort, St. Lucia, West Indies.
First results of researches on nutrition strategies at the Arawak Settlement at Pointe de Caille,NNW Vieux Fort, St. Luicia, West Indies.
Mitteilungen der Prahistorischen Kommission der Osterreichischen Akademie der Wissenschaften. vol. 23.
(Results of the Austrian excavations concerning the nutrition of the Arawak settlement)
"Echinozoa (Seeigel) In samtlichen Proben treten Panzerreste, Kieferreste und Stacheln auf, wahrend solche Reste bei den archaologischen Grabungsarbeiten nicht gefunden wurden. Alle Reste konnen auf sogenannte 'regulare' Seeigel bezogen werden. Eine nahere Bearbeitung steht noch aus.
Echinozoa (sea-urchins)
Parts of the shell, jaws and spines are frequent in all samples, they have been not collected during archeological work. All remains come from 'regular' sea-urchins, they are not worked on now."

Lynn Cannon & Silver 1984. Sea cucumbers of Northern Australia.

Pork Balls and Sea-Cucumbers

Cantonese dish to serve 12

500g pre-conditioned sea cucumber
3 cups oil for frying
1 tbsp cornstarch

2 stalks green onion
2 slices ginger root
1 tbsp rice wine
5 cups water

1/2 tsp salt
1/4 tsp MSG
1/2 egg
1 tbsp cornstarch

250g chopped pork
1 tbsp rice wine
1 tbsp water

1 tbsp black bean paste
1/2 tbsp chopped garlic

1 tbsp oyster sauce
1/2 tsp MSG
1 tsp sugar
1 tsp sesame oil
1/4 tsp black pepper
1 cup stock

Cut sea cucumbers into small pieces and cook for 5 minutes in onion, ginger, wine and water. Drain and discard liquid

Mix pork with egg, salt, MSG and cornstarch. Roll into 14 balls and deep fry over medium heat for 2 minutes. Remove and drain.

Heat pan and 3 tbsp of oil and stir-fry bean paste and garlic, add 1 tbsp of wine and oyster sauce, stock and spices and bring to a boil. Add sea cucumbers and pork balls and simmer until sauce nearly dry (about 10 minutes), add cornstarch and 1 tbsp of oil to thicken and toss ingredients to cover in sauce.

Remove and serve.

Without a permit it is not legal to collect holothurians from marine parks, however, bêche-de-mer may be available through some eastern food outlets. The dried skin of selected species (notably *Actinopyga* spp., *Holothuria (Microthele) nobilis* and *Thelenota ananas*) may be pickled or added to soups and stews. It has a very high protein content and is much prized in some areas of Asia, especially China. The reasons the chinese favour these animals may relate to their enthusiasm for aphrodisiacs - certainly some holothurians are quite phallic and the habit of some to extrude white cuvierian tubules adds to the image. The preparation of sea cucumbers for sale is arduous. Firstly, the fresh animal is washed well and boiled: the larger ones are split open and the guts removed, smaller ones are treated whole. It may then be immersed in sand for two nights after which it is brushed firmly to remove sand and the outer skin layer. Boiling water is then poured over it prior to drying it over a fire.

The purchased dry sea cucumber must be pre-conditioned before cooking.

i Cover with cold water and soak for 12 hours.
ii Simmer for 1-2 hours; ensure always covered with water.
iii Cool to room temperature and drain. Slit open and remove guts if necessary. This procedure may be repeated several times to ensure the animals are thoroughly cleaned
iv Finally soak for 1-2 hours immediately prior to cooking as they must be soft and swollen.


LETICIA
CAVIAR de ERIZOS
HUEVAS DE ERIZO DE MAR
Producto de GALICIA (Costa da Morte)
Fabricado en España
FABRICANTE
CYASA
Conservas y Ahumados, S.A.
A LAGOA, s/n.
VIGO (Pontevedra)
Reg. Sanit. nº 12.853/PO
8 420273 295002
CAVIAR de ERIZOS
(HUEVAS DE ERIZO DE MAR)
PESO NETO: 120 G. PESO ESCURRIDO: 115 G.
CYASA sólo envasa productos de primerísima calidad
CAVIAR de ERIZOS
HUEVAS DE
ERIZO DE MAR
Fácil apertura
SEA - URCHIN CAVIAR
(Sea - Urchin Eggs)
NET WEIGHT: 120 G
DRAINED WEIGHT 115 G
CAVIAR D'OURSINS
(Oeufs d'Oursins de Mer)
POIDS NET: 120 G
POIDS EGOUTTE: 115 G

IN THE PAST

100 years ago (1892)

From the Zoological Record: "While Mr. Bather's record was still incomplete he was compelled to take a voyage, of some months duration, for the benefit of his sight. He has not returned in time to finish his work, the completion of which must therefore be given in the next volume of our Record..."

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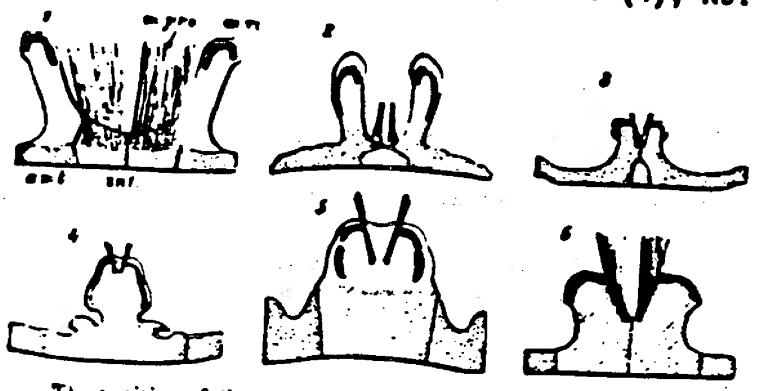

Lóven

The position of the auricles in different types of Echinoides
1 Tripneustes. 2. Clypeaster 3. Arachnoides 4 Echinus 5 Echinocyamus
6. Cidaris

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Seventy-five years ago (1917)

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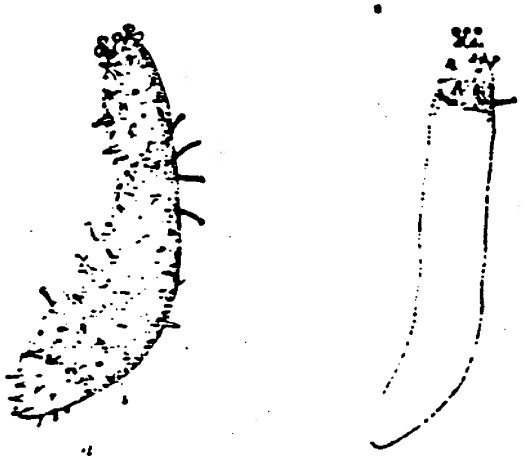

Fig. 1. Regeneration found occurring naturally. Semidiagrammatic sketches, showing differences in pigmentation of a. aboral end, b. oral end. Natural size.

Crozier

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Lillie, R.S. The conditions determining the rate of entrance of water into fertilized and unfertilized egg cells. Am. J. Physiol. 43, 43-57.
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Twenty-five years ago (1967)

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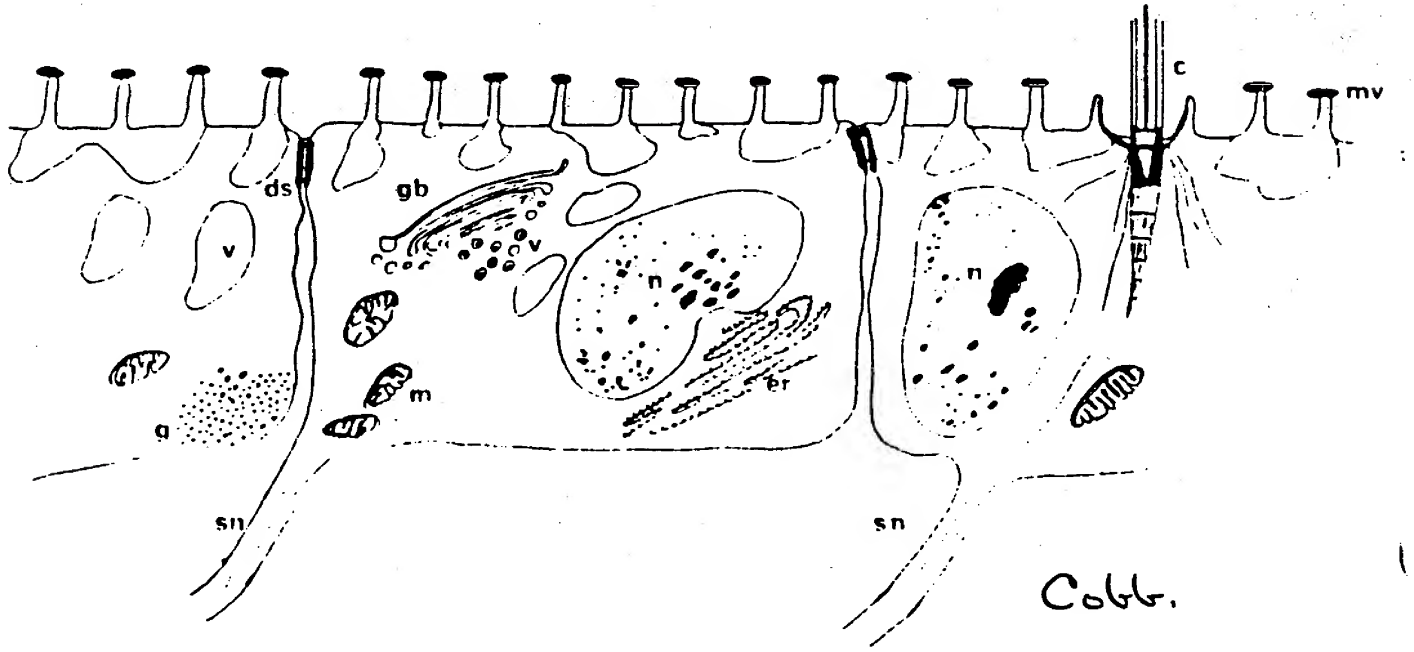

Fig. 1. Diagrammatic representation of the general epithelium of a pedicellaria of *Echinus*. The cells are covered externally with microvilli (mv) and these at one point form a circle round a single motile cilium (c). The cells are joined by a wide desmosomal zone (ds). The cytoplasmic contents of each cell include golgi bodies (gb), glycogen granules (g), endoplasmic reticulum (er), mitochondria (m), and various vesicles and vacuoles (v). There is a large nucleus (n). From each cell arises a single axonic process (sn) containing neurotubules. (Not to scale).

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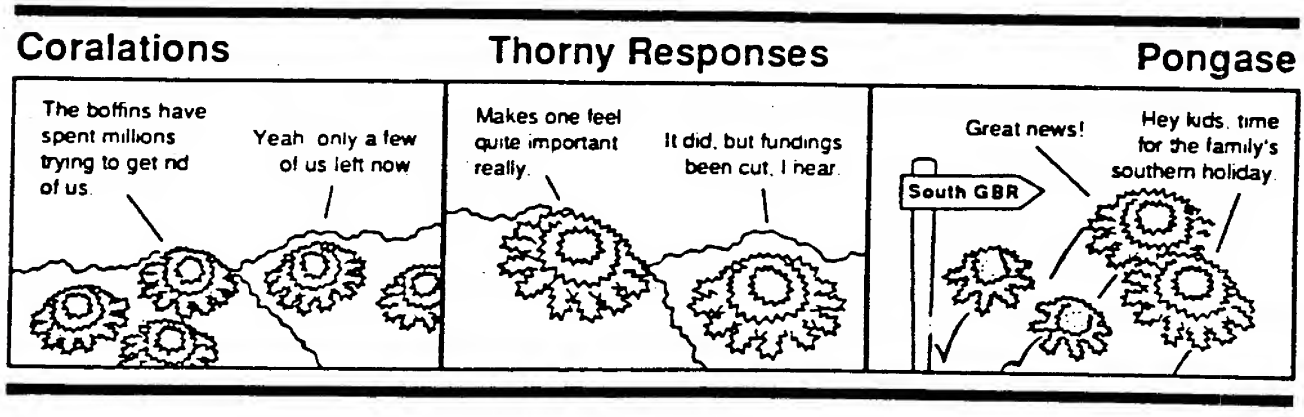

HOW I BECAME AN ECHINODERM BIOLOGIST - PART II

Byrne, Maria (Histology, University of Sydney): As a youngster our holidays by the sea instilled a great interest in marine creatures and I spent hours scouring the flotsum and jetsum along the shore for washed-up treasures. My parents always managed to find space for each load of loot that I returned home with. My husband is equally bemused and when I am away will nip down to the shore between meetings to collect a monthly sample for me, donned with a suit and tie! Once I learned to dive, my eyes were opened to the world of invertebrates outside of "pickle" jars and of all the invertebrate groups, echinoderms held a particular attraction to me, being uniquely marine and so different from the rest. I was first able to explore this interest in my undergraduate research project in Ireland, working with Brendan Keegan. After this, I was well and truly hooked and have been lucky to be able to pursue my interests in echinoderms, seeing some of the world and making reat friends in the process. I became particularly interested in functional morphology and was fortunate to work with Arthur Fontaine in Canada, who has an uncanny understanding of echinoderm form and function. Arthur was a wonderful supervisor, giving me plenty of scope for independent work, but was always there for an insprirational brain storm. It was an exciting time for me working on mutable connective tissues while workers elsewhere ry the world were also making discoveries in this field. Echinoderms are a fascinating gruop with which to address interesting and fundamental questions and now I am steeped in the world of "devo-evo", development and evolution. I have heen lucky so far and hope thatI will be able to continue working with this most rewarding group of invertebrates.

David, Bruno (Paleontological Department, University of Burgundy): I have to admit that I became an echinoderm biologist by pure chance. Surprisingly, it was the French army that pushed me on the track of these spiny animals. Since my childhood I have been interested in natural life, probably largely because both my parents were involved professionally in natural sciences. During my studies at the University of Lyon I was equally attracted by structural geology and by paleontology. After finishing my master's degree, I definitely chose to be a structural geologist, and managed to undertake a PhD on the geology of the Carribean. But to start that project I still needed to get a two-year deferment. As the army refused it, I had to change my plan and switched back to paleontology, starting a study of Tertiary ostracods. After my military service, I moved to Burgundy and Dijon. At that time (1978) I had to engage in a PhD and opted for the paleontology of Lower Cretaceous sea urchins from the Alps. Four years later, pursuing paleontological researches on fossils as a full time researcher, the CNEXO (now IFREMER) offered me the opportunity to study Recent deep-sea forms from the North Atlantic. The fascinating architecture and shape of Pourtalesiids transformed me progressively into a sort of "Recent forms paleontologist". In other words I undertook the study of the evolution of sea urchins from morphological studies of Recent forms, and life has been going ahead in that path ever since.

Donovan, Stephen K. (Geology, University of the West Indies): The British system for the support of graduate students in palaeontology is for projects to be submitted to the Natural Environment Research Council (NERC) for consideration. A committee considers applications and supports a limited number (it used to be about 130) each year, while approving somewhat more so that candidates and departments can make their own decisions on the best combinations. A NERC list of approved projects is published which is a document of great interest amongst final year undergraduates. Competition is fierce.

My interests after 3 years as a geology student in Manchester centered on palaeontology, stratigraphy, and sedimentology, and I applied for a number of projects from the 1980 NERC list accordingly. The only limiting factor that I took into consideration was that I had no intention of returning to London to study, so that I ignored a proposal devised by Ted Rose (University of London) to work on mid-Tertiary echinoids form the Caribbean: if only I'd known then what I know now! However, I was successful in my application for the only other project on the list that was concerned with fossil echinoderms, supervised by Chris Paul in Liverpool. The project was one of obvious potential, analysizing the distribution of crinoid columnals, unloved and generally ignored, in the Lower Palaeozoic of the British Isles. I was shown around the Liverpool campus by Chris and his research assistant, Andrew Smith (was it compulsory toi have a beard to work on fossil echinoderms?), and was the last of five applicants to be interviewed. However, I was offered and accepted the studentship then and there, and the rest is history.

Gebruk, Andrew (P.P. Shirshov Institute of Oceanology, Russia): I am sure there is nothing extraordinary in my story, the usual situation with a student specializing in marine biology (or in my case, in invertebrate zoology), who meets with the leader or teacher.

I grew up in Estonia, on the shore of the Baltic Sea, and spent my summer holidays on the shore of the Black Sea. From my early age I was influenced by the nature of the sea. Since the middle of the school period I was collecting sea shells. This collection is still with me. When I became a student in the Biology Department at Moscow State University there was no doubt that I would specialize in invertebrate zoology. And so it happened. I was planning to start as a malacologist, but in the second year at the University I met George M. Belyaev, the prominent specialist in echinoderms and in the biology of the deep-sea trenches. And he suggested to me that I try a revision of the Scotroplanes, one of the deep-sea holothurian genera. I started visiting the P.P. Shirshov Institute of Oceanology, where Dr. Belyaev worked, more and more often. The revision of the Scoplanes became my diploma work, and since that time the realm of deep-sea holothurians became my profession. Now I work together in the same Laboratory of the ocean bottom fauna with Dr. Belyaev and his other former students: Dr. Alexander Mironov (echinoids) and Dr. Nina Litvinova (ophiuroids).

Giudice, Giovanni (Universita di Palermo, Italy): I started to be interested in sea urchin embryos because there was in the University of Palermo a strong tradition of sea urchin embryology started by Professor Alberto Monroy, with whom I was associated for the first 15 years of my career.

James, D.B. (Tuticorin Research Centre, India): After obtaining my master's degree in marine biology from Andhra University in 1961 I was looking for a research career. At the end of 1962 I was offered a Government of India

Research Scholarship to work at Mandapam Camp (South India) under the supervision of Dr. S. Jones, the then Director of Central Marine Fisheries Research Institute and Founder President of the Marine Biological Association of India. Dr. Jones asked me whether I had any particular problem in mind to work. When I told in the negative, he asked me to discuss with his senior colleagues and come to him. When I met him after one week he asked me to take up the studies on the fascinating group Echinoderms since he already decided to ask his students to work on the little known groups like the Sponges, Corals, and Echinoderms from India. Ever since that time I am working on echinoderms of the Indian Seas. During the last 30 years I have examined material from all along the Indian coast, the Andaman and Nicobar Islands, and the Lakshadweep. I have worked and published papers on the taxonomy, ecology, zoogeography, toxicology, hatchery and culture of echinoderms from Indian Seas.

Levin, Valery (Institute of Marine Biotechnology, Petropavolosk-Kamchatsky, Russia): I became an "echinodermatologist" by necessity. Since 1967 I had been working as the head of a diving group in the Pacific Institute of Bioorganic Chemistry in Vladivostok. My work consisted of making extraction of marine animals for experimental analysis of the chemists. In 1972 I visited the tropical Pacific on board the ship"Dmitry Mendeleev", and made a large collection of marine invertebrates. Our chemists were most interested in holothuroids as they moved from an investigation of plant glycosides (ginseng for example) to animal glycosides. An investigation of the chemistry of almost 40 species of holothuroids was begun, but everyone was ignorant of the species. I was instructed to get to know the species. I took the collection of holothuroids to specialists in the Zoological Institute in Leningrad. To my surprise their knowledge of the tropical species was rather poor. I had no alternative but to surround myself with books, mostly in English which was difficult for me to understand, and learn to identify species by myself. As a result I defended my thesis after five years and my doctorate on the biology of holothuroids after thirteen more.

McKenzie, J. Douglas (Dunstaffnage Marine Laboratory, Scotland): While most echinoderm biologists will be able to tell you how they ended up studying echinoderms, I can tell you the exact moment that decided my career. It was on the 20th of May 1979 at Carrick Castle, in Loch Goil on the west coast of Scotland. I was an undergraduate at Glasgow University at the time and this was my first ever dive. At 20m I hit bottom and there, sticking out of the mud were peculiar animals that I thought looked like polka-dotted anemones. with branched, flame-red tentacles. The next week we were also diving in Loch Goil, opposite Carrick Castle. There again were these peculiar animals but this time I managed to lever one out of the mud using my diving knife and found that there was a very un-anemone like body burrowed in the mud. Bringing it to the surface I dissected it in our diving boat (I was keen in those days!) and recognized it to be a holothurian. Ferretingaround in the library in our Zoology Department I was able to identify it as *Psolus phantapus*. I also quickly found that my lecturers knew next to nothing about holothurians and there seemed to be very little published information about them. It is one of the more perverse aspects of my character that the more other people are interested in something the less interesting I find it and vice versa. A group of animals that no-one seemed to know much about and no-one seemed particualrly interested in struck me as a good subject to do my PhD on. So it was that I started work on sea-cucumbers and this in turn led

me to work on the other classes of echinoderms. Holothurians were my first love and I still have a soft spot for them, particularly *Psolus phantapus*, the animal that started it all. (Jamais arriere)

Mladenov, Philip (Marine Science, University of Otago): I grew up in Toronto with no early exposure to the sea shore. As a youngster, however, I was drawn to books on marine life that my parents seemed always to have about the house. I remember lingering longest on pictures of marine invertebrates, particularly those of the spiny-skinned variety.

This latent interest in marine life and echinoderms transformed into something more concrete early on in my undergraduate years at the University of Toronto. I was fortunate to become involved in Arctic research as a diving assistant and was truly excited about what I saw during dives in Resolute Bay, Corvallis Island. Later, for a project in zoogeography, I embarked on a hopelessly ambitious project involving the origin and dispersal of asteroid families. Nick Holland, another echinoderm biologist, may dimly remember my letter to him asking assistance with this project. I certainly remember his helpful and encouraging reply in the face of what must have seemed to him an outrageous study. While at U of T, I also carried out a project on the behaviour of *Asterias rubens*. I am grateful to my instructor in that course who allowed me to set up a re-circulating salt-water system in his land-locked laboratory and to ship in sea stars and clams, knowning full well that a project on butterflies or minnows would have been much easier and more sensible.

By the time I entered graduate school, my fascination with echinoderms was well established. As an MSc student at McGill University I was given the delightful opportunity by my supervisor, Carol Lalli, to work on just about any sensible project while based at McGill's Bellairs Research Institute in Barbados. It came down to a choice between two projects, one involving brittle stars, the other sea cucumbers. In the end, Carol steered me towards the brittle-star one. After that, I joined Fu-Shiang Chia's group and worked on crinoids while based at the Bamfield Marine Sttion. Towards the end of my dissertation, an important discussion with the late Dr. Robert Fernald of the Friday Harbor Laboratories served to keep me focussed and to convince me that pursuing an interest in echinoderms might indeed lead to a respectable career that would also feed a family.

So that is my story, more or less. It seems I may have become an echinoderm biologist because of an inherent interest that manifested itself early in life within the framework of a supportive family environment, combined with the good fortune of being exposed to broad-minded instructors and supervisors who were able to nurture the interests of a young biologist early in his career, and who also provided sensible advice at the times it was needed most.

Regnell, Gerhard (Geologiska Institutionen, Lunds Universitet): In the late 1920's I brought together a small and indeed very diverse collection of natural objects. My "cabinet of curiosities" has of course been disposed of long ago, but I still have a vivid memory of some of the treasures. Among these were cylindrical and annulated pieces which I had picked in the clay of a local brickyard. I had not the faintest idea of their true nature but took them for fossilized earth-worms. Eventually, I realized that the worms were in fact fragments of stems of Silurian crinoids which had been transported from the Island of Gotland by ice-streams in Pleistocene times. Other objects were more obvious. Quite trivial were steinkerns of Cretaceous sea

urchins which you could collect in quantities in the fields. In a class of itself was an exquisite speciement of -as I now know- *Trisalenia loveni* collected during my first visit to the Isle of Ivo in northeast Scania where there is a quarry in Upper Cretaceous rocks.

Not until many years later did I again come into contact with echinoderms. In 1933 I matriculated at the University of Lund in south Swweden in order to study natural science. I then met Torsten Gislen (1893-1954), professor of zoology, who was, and probably still is, well known from his studies of echinoderms, particularly crinoids, and maybe in the first place from his ideas of affinities between echinoderms, enteropneustes and chordates, a question which is still under dispute. I cannot say that at that time Gislen exerted any influence upon my choice of Lower Palaeozoic non-crinoid pelmatozoans as the theme for my doctoral dissertation several years later. But when working on my thesis I profited very much from discussions with Gislen.

Iconographia crinoideorum, the classical monograph by N.P. Angelin (1878), includes a condensed section on cystoids for which Sven Loven, also a classic among echinodermologists, was in charge. Afterwards, little attention had been given to the Swedish material. In view of this fact, professor Erik Stensio, Director of the Department of Palaeo-zoology of the Swedish Museum of Natural History in Stockholm, suggested to me to deal with cystoids and related groups. This I did in the period 1940-45, i.e. during World War II. It goes without saying that conditions for scientific work were not the best: You could not vist foreign colleagues or collections or obtain material for comparison, even correspondence with colleagues in other countries was practically impossible, photographic plates of sufficient quality were almost impossible to obtain, etc. Anyway, I completed my work and eventually came in touch i.a. with grand old men in the science of fossil echinoderms, like N.N. Yakolev and R.F. Hecker in the then Soviet Union and R.S. Bassler in the United States, all of which meant a good deal for my future work.

Looking back, I find it hard to realize that I encountered fossil echinoderms for the first time some 65 years ago. They are still around.

Roman, Jean (Institut de Paleontologie, Museum National d'Histoire Naturelle): My career as an echinologist was the realization of a dream: that which made many boys and girls fascinated by paleontology and who wanted to make it their profession. Like a large number of children I began by collecting fossils and by making a small collection. But I had the great fortune of being born in a family of naturalists: a great grandfather who was an artist, very much taken with nature and a collector of shells, minerals, and insects; a grandfather who was a professor of geology and a respected specialist on ammonites; a father who had a great knowledge of plants and who was a amateur entomologist. My grandfather would take his grandchildren to the areas near Lyon to collect fossils: gryphea (oysters), scallops (Pecten), and naturally ammonites, as well as a bizarre fossil, called by my grandfather "le fromage du pere Adam" (the cheese of father Adam) which is the product of the activity of a marine worm. Sometimes one saw as well the "coups de balai" (broom sweeps) which are the remains of alcyonarians related to gorgonians. I began my higher studies at Lyon and finished them at Grenoble, near the mountains. I had my first contact with echinoids in the Cretaceous of the southern Alps. Then Professor J. Roger called me to Paris to the Museum. He had just established the Center for Paleontological Study and Documentation. I would have loved to devote myself to the study of

ammonites. Now he proposed to me a subject of research on the echinoids and I had the opportunity to identify a large number of them. These organisms have less value than ammonites for dating formations, but they are much more interesting. In fact, the fossil urchins offer for observations a much larger number of anatomical structures than most of the other fossils, and these structures are directly linked to the life of the animal. They teach us about its way of life and its environment.

Rowley, Robert J. (Marine Science, Univ. of Otago): I started studying sea urchins when they ate the kelp bed in which I was studying fish. Since then I have become fascinated with echinoderms because they are often important or dominant in marine communities and they are so unlike most other taxa. The difficulties of working with them in field studies(difficult to tag or sometimes even measure, cryptic recruits, generally no good "growth rings") actually create opportunities for research if you can find innovative ways to "get a handle" on the wierd and wonderful critters.

Smiley, Scott (Institute of Arctic Biology, Univ. of Alaska): Although I recall finding my first sea cucumber on the Maine seashore when I was 5 years old, my obsession with them really began with a poorly produced nature show on TV in the late 60s called Oceans Alive. The TV naturalist squeezed a tropical Pacific sea cucumber and two pearl fish squirted out of its anus. I was fascinated and revulsed, but the fascination was intense. I spent an undergraduate semester in a marine lab working on gregarine parasites of a local sea cucumber. My interest in them grew until, by the time I graduated, I was a confirmed student of the Holothurians. In graduate school, I found myself asking advisors why I should not use a sea cucumber to answer this or that question. I was intrigued by the idea that sea cucumbers were so obscure that I might be able to read everything written about them while in graduate school. This is not to diminish the natural obscurity of their biology; the main reason there is so little written about them is because of their obscure biology. I felt that to understand Zoology, one must deeply understand a non-vertebrate animal. I also believe that Zoology is just another mode of human self expression. I chose to express myself through Zoology, and I chose to explore the manifold aspects of Zoology through sea cucumbers. I have read that unforeseen qualities emerge in a detailed multidisplinary understanding of a coherent group of animnals. I would like to believe that this is true, but I suspend my judgement on this optimistic view until I finish my work. I have studied sea cucumbers for 15 years now. I continue to study them, and I plan to study them for the foreseeable future. I still find them endlessly fascinating; in their molecular biology and biochemistry, their cell biology, their physiology, their development, their ultrastructure and anatomy, their taxonomy and systematics, and their natural history. I am even beginning to discover that their ecology is fascinating, in spite of the fact that this discipline is overwhelmingly complex for me. Like other children of the early 60s, I was preoccupied with fears of nuclear war, and a refleciton of this fear congealed in the tyranny depicted in the movie FAHRENHEIT 451. I suspect that I found solace in the thought that I might become the book of sea cucumbers.

Stickle, William (Dept. of Zoology, Louisiana State Univ.): My fascination with the echinoderms began in 1966 when, as a M.S. student, I travelled to Seattle to present a paper at the American Malacological Union, Pacific Division and we took a field trip to lower Puget Sound where I was impressed with the species diversity and bright coloration of the intertidal echinoderms. My curiosity about the physiological adaptations of echinoderms was whetted a year later when I took part in an Oceanography Institute program at the University of Alaska's marine laboratory on Douglas Island which was located near Juneau. I was puzzled at the euryhalinity of a number of intertidal species of sea stars, sea urchins, brittle stars, and sea cucumbers when exposed to the freshwater lens which develops in coastal areas receiving freshwater input from melting glaciers during the summer months. Echinoderms were and are considered to be very stenohaline but the species observed in the vicinity of Juneau had not read that book! My education in the lessons taught about the role of echinoderms in the biological world matured when I spent a year at the Friday Harbor Laboratories and learned much about their natural history. I remain in awe of echinoderms some 25 years after my introduction to their beauty, diversity, and hidden secrets.

Tommasi, Luiz Roberto (Instituto Oceanografico, Universidade de Sao Paulo): I began to work with echinoderms because they are one of the most exotic, extraterrestrial group of marine invertebrates. Because of its fantastic geological history. And because not only in the sky we can find stars.

Yanagisawa, Tomio (Saitama Medical School, Japan): A short abstract (in Japanese) issued in Japan shortly before 1945 of Lindahl's work (1940) on the animalization of sea-urchin embryos by Li+-treatment evoked my first interest in echinoderm embryology. Amphibian metamorphosis was my first subject, but at the start of my doctoral thesis, my early emotion to echinoderm embryology and the reports on the nature of phosphate compounds in sea-urchin eggs by Whiteley (1949) and by Chambers (1953) led me to study the phosphagen-phosphagen kinase systems in gametes of sea urchins and starfish. i) The study elucidated the differential distributions of APK and CPK systems in echinoderm eggs and sperm (J. Fac. Sci., Univ. Tokyo, IV.8, 473, 481, 1959). Other early works were ii) studies on the acid-soluble nucleotides in sea-urchin eggs (in collaboration with Dr. N. Isono), in which we demonstrated the changes in the amounts of ATP and other nucleotides during development and the presence of UDP-sugar compounds (see Embryologia, 9, 184, 1966), and iii) studies on the flagellar movement of sea urchin sperm (in collaboration with Dr. H. Mohri), in which we elucidated the essential role of GTP bound to the microtubule protein and named the GTP-binding protein as "TUBULIN" (Exp. Cell Res. 52, 86, 1968). These early works opened the way for me to study the comparative biology of echinoderms.

GREAT INVERTEBRATE ZOOLOGISTS: LIBBIE HENRIETTA HYMAN (1888-1969)
(by Judith Winston)

When I think of Libbie Hyman, I think of three portraits: dreamy schoolgirl, laughing teenager, stern elderly woman. The old woman was known to me first. In invertebrate zoology class we naturally learned of Libbie Hyman's great treatise on the invertebrates. "But," confided the professor, "she looks like King Kong." His words were frightening. If studying invertebrates turned you into a monster, maybe it was time to switch fields. I stopped at the University library to find an illustrated biography. It was a great relief to discover the professor was wrong; the face on the page was elderly and severe, the eyes too wide set, the nose and cheekbones a little distorted, but that was all. Reassured, I returned to studying invertebrates, eventually arriving in the Department of Invertebrates at the American Museum of Natural History in New York City, the very place where Libbie spent the latter part of her career and where she composed her treatise. In department files I discovered additional portraits and renewed my interest in the story of her life.

Libbie Hyman was born in Des Moines, Iowa on December 6, 1888, third child and only daughter of Jewish immigrant parents. Her mother, Sabina Neumann was from Stettin, Germany; her considerably older father, Joseph Hyman, from Konin, Poland. Most of her childhood was spent in Fort Dodge, Iowa where her father had a clothing store. Her mother was strict and undemonstrative. Her father was self-educated but scholarly; their home contained several books, including Shakespeare and Dickens. From childhood on Libbie had a strong interest in natural history, especially botany, but this was not encouraged by her parents, who saw her role primarily as assistant to her mother in household tasks and the care of her brothers. My favorite portrait shows Libbie as a bright-eyed school girl of 6 or 7, dressed in ruffled Victorian style, her dark hair coaxed into stiff ringlets. Hand on cheek she gazes pensively into the distance. As I look at her, I am reminded of my own young daughter, but also that, in a scientific sense, it is I who am her daughter. All of us invertebrate zoologists are her descendents, although she had no children of her own.

After graduating as valedictorian of her high school class in 1905, Libbie took a job in a factory, pasting labels on oatmeal boxes. One fall morning in 1906 she happened to meet a former high school teacher, Mary Crawford, who told her of tuition scholarships available at the University of Chicago. Thanks to her teacher's efforts, a few weeks later, Libbie entered that university. She found part-time jobs to pay room and board. Libbie blossomed, taking a variety of science courses and enjoying freedom from her restrictive family. Pursuit of her first love, botany, was discouraged by anti-semitic harassment doled out by a lab assistant. The Zoology Department, however, encouraged her to make a career in zoology. She achieved her bachelor's degree in 1910 and, working under professor Charles Manning Child, recieved her Ph.D in 1915. As a graduate student, she supported herself with teaching assistantships.

A snapshot taken during her college years shows her laughing, arms flung back and hands clasped behind her head, full of joy, beauty, and energy. But two events occuring during that time had a profound effect on the rest of her life. In 1907, her father died and her mother and brothers moved to Chicago. She was once more expected to live at home and be a household slave, receiving nothing but derision for her studies. The second event was a bungled sinus operation in 1916, which impaired her health and over time had an increasingly negative effect on her looks.

Libbie Hyman claimed never to have wanted an academic teaching position (at the time very difficult for a woman to find, in any case). Instead, she continued as Child's assistant, carrying out experiments on the physiology of planarians and other invertebrates. She also wrote two lab manuals for which, as teaching assistant, she had seen a need. In 1919, she published a manual for Elementary Zoology -- its success astonished her. In 1922, she published a manual for Comparative Vertebrate Anatomy which was also highly successful. She later claimed that The Invertebrates was first conceived as a laboratory guide similar to the others she had produced - she had no idea it would grow to six volumes. The success of her first two books eventually brought her financial independence. In 1930, after her mother's death and with Child's retirement approaching, she broke from Chicago (and the housekeeping demands of her bachelor brothers) to find a place where she could pursue her invertebrate work in peace.

After a 15 month tour of Europe, Libbie settled in the New York area. She contacted G.K. Noble, founder of the Department of Experimental Biology (later known as Animal Behavior) at the American Museum, who offered her use of the facilities. In 1937, she was officially made a Research Associate in that department and assigned an office. Volume I of her treatise appeared in 1940. That year she bought a home in Millwood, N.Y., about 35 miles from N.Y.C., where she could indulge her passion for gardening. Though she later regretted the time spent on her garden and commuting, that was one of the happiest and most productive periods of her life. She wrote volumes II and III (published in 1951) during that time. After the retirement in 1943 of Department of Invertebrates chairman, Roy Waldo Miner, who by all accounts was hostile to both women and Jews, she transferred to that department, an association she retained until her death. All who knew Libbie agree that she stayed completely away from the political aspects of museum life. She did not socialize with her colleagues. She spent most of her time in the library and her chief friends at AMNH were the librarians. Those who met her at the Museum found her brusque, even rude. She was impatient with interruption although eager enough to talk with anyone having knowledge relevant to the volume in progress. In the library, she read the literature and made note cards on each article but, once those were digested, she composed each book directly in her head and typed the first and only draft on her ancient manual typewriter. She taught herself to draw professionally enough to make the illustrations.

Her New York manner contrasts with stories told by those who knew her at the various marine laboratories where she spent summers gathering material for her books. Former students tell of someone enthusiastic, helpful, who seemed to be everywhere in lab at once, who was pleased and excited by living invertebrates. Pictures taken by the shore show her relaxed and smiling, a stark contrast to her severe expression in AMNH portraits.

In 1952, at the age of 65, Libbie returned to N.Y.C. to an apartment hotel near the Museum. She enjoyed the city's cultural pursuits, attending concerts with her librarian friends and acquiring a small but valuable art collection. But mostly she worked on her treatise, obsessed with the immensity of the task she had set for herself. Volume IV appeared in 1955, Volume V in 1959. Fame had come almost as soon as the first volume was published; she was awarded an an honorary degree from the University of Chicago in 1941. Other honors followed, including membership in the National Academy of Sciences, the Elliot Medal (1951) and the Gold Medal of the Linnean Society of London (1961). Around 1956 she developed symptoms of what was eventually diagnosed as Parkinson's disease. By the time of her death, in 1969, she was wheelchair-bound and dependent on nursing care, but she kept working almost to the last.

Libbie Hyman did not see herself as a research scientist, although she published more experimental papers than many scientists ever do. She was president of the Society of Systematic Zoology (1959) and edited its journal, Systematic Zoology, from 1959-63, but she apparently had little interest in systematic theory, preferring practical approaches. She claimed her major work to be "essentially a compilation from the literature," and considered her assets to be "some fluency in translating the major European languages and an ability to select and organize material in the literature." Yet, invertebrate zoologists have found that she did much more than compile. Her books provided a synthesis of phylogeny that clearly influenced teaching and opinion about the groups she covered. While discoveries of the last 30 years have resulted in many changes in our thinking about invertebrate phylogeny, her work still provides a framework against which new ideas can be tested and sets a standard of excellence that can still inspire us.

Note: This brief history is based on her own autobiography in department files, Horace Stunkard's obituaries, the chapter on Libbie Hyman in the 1943 book American Women of Science by Edna Yost, and on conversations and correspondence with people who knew her.

Michael Sars and the naturalist tradition in Norway

Michael Sars was born in Bergen, Norway in 1809. He studied natural history and theology at Royal Frederic's University in Christiania (these days University of Oslo) from 1823 and completed a degree in theology in 1828. For the next several years he taught at a number of different schools, both high schools and primary schools, first in Christiania, then in Bergen in 1830-31. In 1831 he was appointed vicar to Kinn on the Norwegian west coast; eight years later he transferred to Manger, just north of Bergen. Finally, in 1854 he was named extraordinary professor of zoology at the University where he remained for the rest of his life. He died in 1869. He married Maren Welhaven in 1831 and had 7 daughters and 7 sons.

I first want to place Michael Sars into the history of Norway. The "double-monarchy" with Denmark was terminated in 1814 and Norway more or less donated to Sweden by the great European powers (Austria, Russia and England) as a reward for Sweden being on the winning side in the Napoleonic wars. During the Spring of 1814 the Norwegians formed a National Assembly which wrote a Constitution and appointed a separate King. Needless to say, this complicated the negotiations between Norway, Sweden and the great powers. As a result, Norway managed to negotiate a rather loose Union with Sweden, retaining its Constitution, Parliament and in part, a separate set of ministers. Parenthetically, the necessary infra-structure to run Norway as a separate country was not present so the Union with Sweden, in hindsight, was probably a blessing.

Several Norwegian vicars trained at the University in Copenhagen during the Enlightenment period (mid - late 1700's) wrote descriptions of one district after another of their country. Most of these descriptions are not usable as scientific articles, but they definitely formed a solid background of information available to the next generation of naturalists. An Academy had been started in Trondhjem by Bishop Gunnerus (famous as the discoverer of the copepod Calanus finmarchicus). Through interaction between Gunnerus and Linnaeus in Sweden, all sorts of marine organisms were named in one edition after another of Linnaeus' Systema Naturae. Further south in the country, in the Oslo-fjord, a Dane, Otto Friedrich Müller, had described many species from Dröbak in his overview of the "Danish" fauna. The University in Christiania was started in 1809 and the Museum in Bergen dates from 1825.

Michael Sars issued his first publication in 1829 (Contributions to the natural history of marine animals); a second major publication followed in 1835 (Descriptions and Observations etc.). He also issued two large-scale volumes under the title **Fauna Littoralis Norvegiae**, partially in collaboration with amateur biologists associated with the Museum in Bergen. In all these publications Sars described new taxa, a routine activity of scientists of the period, but he also described life-histories and reproductive cycles, food and feeding, behavior and geographical dispersal. The well known British zoologist, Edward Forbes, had issued a series of widely dispersed articles on

biogeography, claiming that at depths greater than 300 fathoms, no animal life existed. Sars and his colleagues knew better and in a series of reports issued in various Norwegian journals, he documented the presence of a number of taxa in Norwegian fjords. As a result of one of his dredging expeditions, Sars described Rhizocrinus lofotensis, the first living stalked crinoid to be described. This find, with other similar finds, spurred interest in the deep-sea and were important as an academic excuse for the **CHALLENGER** and other similar expeditions around the globe in the 1860's through 1880's.

Sars was one of the last zoologists to describe organisms more or less equally successfully in all major animal groups. The next generation of zoologists, including Michael Sars's son George Ossian Sars, tended to concentrate their activities more and more on limited groups (if an "Account of the Crustacea of Norway" can be said to be a restrictive title). Michael Sars also described fossils for various fossil beds in Norway and appears to have been keenly interested in all sorts of other issues. More importantly, his observations on the living organisms place Michael Sars squarely in the tradition that eventually lead to the development of the fields of physiology, reproductive biology and ecology. Many of his reports on his observations are anecdotal in nature: descriptions and illustrations of what took place in his glass-dishes etc. For example, Sars must share with Dalyell the honor of describing the life-history of Aurelia aurita and more generally of scyphozoans. The documentation consists of piecing together series of observations taken over time and only partially through following single indidivuals over a longer period of time and very little of statistical treatment was attempted (not least since very little of statistic existed!). This kind of documentation is hardly ever accepted any longer as sufficiently scientific. The Natural Historians in the mid-1800's however used the method extensively and with great success. Sars was also asked by the Norwegian Parliament to investigate the biology of Norwegian fisheries, such as the herring and cod fisheries. He had gotten well started on these investigations, but most of these investigations were completed by G.O.Sars after the death of his father.

By the time G.O. Sars had issued the last of his fathers posthumous papers, a very solid taxonomic base had been developed for marine zoology in Norway. In many ways, inshore work in Norway since the death of Michael Sars has been a series of commentaries on projects he had discussed or on distributional or developmental proposals he had already suggested. We can refine to some extent morphological descriptions based on better collections and instrumentation than was available to Sars, but, at the magnifications he had available to him, these refinements are in detail rather than in overall understanding of the morphology of the organisms studied. Specimens described by Sars are still very largely present in the Zoological Museums in Oslo and Bergen. As a strict museum professional Sars left a lot to be desired: labelling and tracking of specimens were definitely not his strong suits. However, the specimens are there and form

the background for our understanding of the northern quarter of the eastern Atlantic Ocean.

Michael Sars position in Norwegian intellectual history is interesting. He was, as stated above, married to Maren Welhaven, the sister of one of Norway's best known epic poets, J.S. Welhaven. Two of his sons, George Ossian and Johan Ernst Sars, became professors at the University, one following his fathers footsteps, the other a historian. Two of his daughters were well known singers and premiered songs composed by Grieg and Nordraak to texts by some of Norway's greatest writers such as Ibsen and Björnson. Sars and his family spanned the academic and artistic culture of the country and very much represented the National Romantic view of the indigenous culture.

Michael Sars was in contact with scientists all over Europe and in the United States. He corresponded with them, visited with them when he had the opportunity, and was extensively and very rapidly quoted in the European literature. Even papers published in Norwegian reached the scientific audience in the European museums so his contemporary influence was great.

Sars and his contemporaries, the first post-Linnean generation or scientists, described the morphology of the animals they studied and at the same time, gave them scientific names. The next generation included microscopists, describing histological detail using newly developed techniques, but this generation also saw the split between scientists describing structures and scientists specializing on naming new taxa. Sars and his contemporaries were by and large the last zoologists to use all available techniques to study their favorite organisms. Because of the activities of Sars and others like him, the amount of information about different organisms became too large for any scientist to handle. In addition, so many divergent techniques of study developed that no zoologist could effectively stay in the forefront of all sections of Zoology. Today, Michael Sars is perhaps best remembered as the author of numerous marine invertebrates; his studies were however, also important for their influence on what by now have come to represent very divergent parts of zoology.

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OBITUARIES AND DEATH NOTICES

Broadhead, T.W., T.J. Forrest. H.C. Strimple. J. Paleontol. 60,192-195.
Campbell, H. 1989. John Vaughn Thompson. F.L.S. Proc. Linn. Soc. N.S.W. 111, 45-64.
Aldrich, Frederick A. (exerpt of letter from Margueritte M. Aldrich, 29 March 1992): "...my husband, Dr. Frederick A. Aldrich, died on July 12, 1991. In our early life together when we were young, poor graduate students, our primary interest was echinoderms..."
D.P. Wilson. (from the 1991 Annual Report of the Marine Biological Association of the United Kingdom)

Dr D.P. Wilson died suddenly on 20 December 1991 aged 89. Born in Manchester he started work in the cotton industry but his main interest was in natural history and he entered Manchester University and in 1926 graduated with a first class honours degree in zoology. During his undergraduate years he had attended field courses at Millport, Port Erin and Plymouth. Awarded a DSIR grant to work on polychaete development he came to Plymouth in September 1926. In 1927 he was appointed student Probationer at the Laboratory and joined the staff as Assistant Naturalist in 1928. He retired in 1969 having served as Deputy Director since 1958. 'D.P.', as he was known to most of his friends, was internationally renowned for his studies on the factors controlling metamorphosis of marine invertebrate larvae, for his beautiful photographs of marine life and his development of the Aquarium at the Plymouth Laboratory.

The early research of D.P. involved describing and rearing in the laboratory the larvae of invertebrates, especially polychaetes and echinoderms. The search for the best conditions for development was coupled with his interest in having a supply of 'good water' for the Aquarium. Also these beautiful larvae proved ideal subjects for D.P.'s early experiments with flash photography.

During the 1939-45 war D.P. stayed in Plymouth and helped to organize the air-raid precautions and was part of the team that helped to save the major part of the building during the air-raids on 20 March 1941. During the periods 1930-40 and 46-48 D.P. was in charge of the organization of the well-known Plymouth Easter Classes. During these periods 584 students attended the classes and many zoologists must be grateful to him for introducing them to marine biology. In 1957 he edited the third edition of the *Plymouth Marine Fauna*.

Aside from the laboratory and his photography D.P.'s main activities were with his family and with the Plymouth Athenaeum of which he was an active member, and President in 1961-62.

In 1931 D.P. married Miss M.A. Westbrook who was carrying out research at Plymouth on marine red algae for her PhD. Alison completed her Doctorate and then gave up formal research to become a housewife and mother. She was the ideal companion to D.P. with her keen interest in natural history, photography and local history. She died in 1981 and D.P. managed to make the adjustment, lived on alone and looked after himself, with the help of home helps, until his death. The older members of staff and visitors will miss D.P. but his superb photographs will remain with us as a memorial.

H. Manelli. 1992. Enrico Tortonese et son oeuvre. In: L. Scalera-Liaci & C. Canicatti. (eds.). Echinoderm Research 1991. Balkema. pp 1-7.

Echinoderms available at the Bahamiam Field Station, San Salvador, Bahamas (from : F. Diehl, D. Mellon, R. Garrett, N. Elliott. Field guide to the invertebrates of San Salvador Island, Bahamas. Contributed by J.B. McClintock).

Scientific Name (Common Name)

PHYLUM: ECHINODERMATA

Class: **Asteroidea**
Family: Astropectenidae
Astropecten sp.

Family: Oreasteridae
Oreaster reticulatus (cushioned star)

Family: Ophidiasteridae
Linckia guildingii (common comet star)

Family: Echinasteridae
Echinaster spinulosus

Class: **Ophiuroidea**
Family: Ophiactidae
Ophiactis savignyi (Savigny's brittle star)

Family: Ophiotrichidae
Ophiotrix oerstedii (Oersted's brittle star)
Ophiothrix swensonii (Swenson's brittle star)

Family: Ophiochitonidae
Ophionereis reticulata (reticulate brittle star)

Family: Ophiocomidae
Ophiocoma echinata (black brittle star)
Ophiocoma wendtii (red ophiocoma)

Family: Ophiodermatidae
Ophioderma appressum (snakeskin brittle star)
Ophioderma brevispinum (short-spined brittle star)

Family: Ophiomyxidae
Ophiomyxa flaccida (slimy brittle star)

Class: **Echinoidea**
Family: Cidaridae (club urchins)
Eucidaris tribuloides (club pencil urchin)

Family: Diadematidae
Diadema antillarum (long-spined urchin)

Family: Arbacidae
Arbacia punctulata (common arbacia)

Family: Echinidae
Lytechinus variegatus (green urchin)
Tripneustes ventricosus (sea egg)

Family: Echinometridae
Echinometra lucunter (rock-boring urchin)
Echinometra viridis (green rock-boring urchin)

Family: Clypeasteridae
Clypeaster rosaceus (brown sea biscuit)

Family: Scutellidae
Mellita sexiesperforata (six-hole urchin)

Family: Spatangidae
Meoma ventricosa (West Indian sea biscuit)
Plagiobrissus grandix (great red-footed urchin)

Class: **Holothuroidea**
Family: Holothuridae
Stichopus badionotus (four-sided sea cucumber)
Actinopyga agassizii (five-toothed sea cucumber)
Holothuria thomasae (Thomas's cucumber)
Holothuria mexicana (donkey dung sea cucumber)
Holothuria princeps
Holothuria grisea (gray sea cucumber)
Parathyone surinamensis

Family: Synaptidae
Euapta lappa (sticky skinned sea cucumber)
Chirodota rotifera (Pourtale's sea cucumber)

Family: Cucumariidae
Pentacta pygmaea (pygmy sea cucumber)

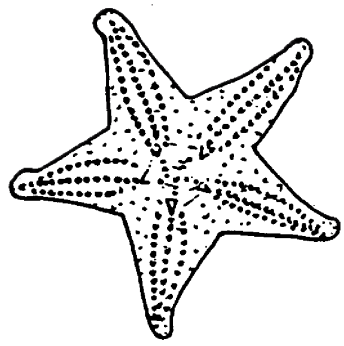
Class: **Crinoidea**
Family: Comatulidae
Nemaster discoidea (beaded sea lily)

ECHINODERMATA

ASTEROIDEA

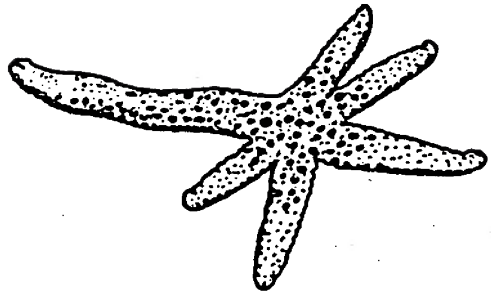
Oreaster reticulatus, Cushion Sea Star

Up to 20 inches. 5 pointed, thick, short arms; thick-bodied. Firm, hard, spiny skeleton. Juveniles green, adults orange to brownish red with reticulate pattern of squares and triangles. Ventral surface yellowish. Two rows of thick tube feet. Found in shallow (6 ft) water on sandy or grassy bottoms. It is becoming locally rare because of its attractive size, color and ease of collecting. This is unfortunate, especially since specimens deteriorate rapidly and cannot be preserved.



Linckia guildingii, Common Comet Sea Star

Medium size, up to 9 inches. Long, slender, parallel-sided rays with blunt tips. Rays are 10 times body diameter. Surface smooth to the touch, feels turgid. Flesh colored, tan or reddish. Linckia shows remarkable regenerative powers. A single arm can generate a new animal; from its body end, small new arms bud out, giving it a comet-like appearance where the parent ray represents the tail of the comet. Often has 6 arms. Found in shallow water on sandy bottoms or reefs.



Echinaster spinulosus, Brown Spiny Sea Star. Also known as West Indian Star.

Medium size-up to 6 inches, 5 long tapering arms, with short spines of contrasting color. Greenish or reddish brown. Found on soft bottoms in mangrove channels. Echinaster sp. are attracted by light and are often found in the open on sunny days.